VIRGINIA RESPONSIBLE LAND DISTURBER CERTIFICATE OF COMPETENCE PROGRAM

APPLICANT PACKET

Virginia Department of Conservation and Recreation
Division of Soil and Water Conservation
Urban Programs

How To Use The Applicant Packet:

1. **All of the information required to correctly answer the RLD Certification examination/test questions is contained within this packet.**

2. **The applicant should become familiar with this information.**

3. **The applicant is not expected to read or memorize all of this information. The exam is timed (1hour) and open book.**

4. **The applicant should bind, tab, and highlight the 3 sections of the packet separately so correct information can be rapidly and easily located. The exam questions and packet are organized into these 3 separate sections: Law and Regulations, Principles and Practices, and ESC Specifications.**

5. **The applicant should become very familiar with the table of contents and the ESC Specifications index so that correct information can be quickly located.**

About the RLD Certification Exam/Test:

1. **The exam will consist of 25 multiple-choice questions.**

2. **The exam is open book and timed (1 hour long).**

3. **The exam will be administered over the internet through any computer (with printer) that has access to the DCR exam website.**

4. **All of the information necessary to correctly answer the questions can be found in the Applicant Packet. The packet is available free of charge from the DCR website.**

5. **The exam and the packet are organized into 3 sections:**

Law and Regulations will have:	**5 questions**
Principles and Practices will have:	**5 questions**
ESC Specifications will have:	**15 questions**
Total Exam Questions:	**25 questions**

6. **If the applicant answers 17 or more of the exam questions correctly he or she will receive their printed RLD Certificate and DCR website listing instantly.**

7. **If the applicant answers 13 or more of the exam questions correctly but less than 17 questions correctly then a free retest will be available. The free retest will be 10 questions and 25 minutes long. The free retest will cover only those sections of the exam that the applicant answered less than 80% correct. Further directions on the free retest will be provided to those that qualify.**

8. **If the applicant answers 12 or less questions correctly then he or she will be required to take the entire exam again at the full fee to obtain certification.**

9. **No two exams are the same. All exams are composed of randomly sorted questions from a database of over 1200 questions.**

10. **The RLD certification application fee is $90 and the certification will be valid for 3 years beyond the date of issuance.**

11. **Major credit cards will be accepted via the website. No cash or checks will be accepted by DCR.**

12. **The certification exam is anticipated to be available 24 hours a day/seven days a week from any computer (with printer) that has internet access to the DCR website at www.dcr.state.va.us/sw/e&s.htm on or before June 27, 2001.**

TABLE OF CONTENTS

INTRODUCTION

The Virginia Erosion & Sediment Control Law (Title 10.1, Chapter 5, Article 4 of the Code of Virginia) (Law) delineates the rights and responsibilities of the governments that administer the Commonwealth of Virginia's Erosion and Sediment Control (ESC) Program and the property owners who must comply. The ESC Program is intended to control soil erosion, sediment deposition, and nonagricultural runoff from regulated "land-disturbing activities" to prevent degradation of property and natural resources. A network of locally operated ESC Programs regulates most private projects that involve a land-disturbing activity, while state agency projects are overseen by the Virginia Department of Conservation and Recreation (DCR).

The "Responsible Land Disturber (RLD) Certificate of Competence Program" was established as a component of the ESC Program by revisions to the Law that became effective on July 1, 2001. Beginning in July 2001, as a prerequisite for erosion and sediment control (ESC) plan approval, the person responsible for carrying out the plan must provide the name of an individual holding an RLD Certificate who will be in charge of and responsible for carrying out the regulated land-disturbing activity. To meet this mandate, DCR operates the RLD Certificate of Competence Program.

The principal objectives of the RLD Certificate of Competence Program are:

1. To present a wide array of educational material that promotes a baseline understanding of the Law, Regulations and Minimum Standards, basic ESC principles and practices, and ESC specifications (measures) from the *Virginia Erosion & Sediment Control Handbook* to those individuals responsible for land-disturbing activities regulated in the Commonwealth,

2. To issue a RLD Certificate of Competence to individuals who demonstrate ESC competence through an on-line or proctor assisted examination, and

3. To improve ESC compliance throughout the Commonwealth to ensure protection to property and natural resources.

This *Applicant Packet* is broken up into the following three Sections: (1) Law and Regulations; (2) Principles and Practices; and (3) ESC Specifications. This *Applicant Packet* highlights key technical, regulatory, and policy features of the ESC Program that are essential for effective and efficient on site ESC plan implementation.

Further information on the RLD Certificate of Competence Program and copies of program publications are available through DCR's website at www.dcr.state.va.us/sw/e&s.htm.

LAW AND REGULATIONS SECTION

LEARNING OBJECTIVES

1. To become familiar with essential terminology in the Virginia Erosion & Sediment Control Law.
2. To understand the land-disturbing activities that are regulated by the Virginia Erosion & Sediment Control Law.
3. To understand the regulatory authority for land-disturbing activities on private, state, and federal lands under the Virginia Erosion & Sediment Control Law
4. To learn the 19 Minimum Standards for erosion and sediment control mandated by the Virginia Erosion & Sediment Control Regulations.

INSTRUCTIONAL ELEMENTS

DEFINITIONS

Below are the definitions of several terms that are essential to understanding the Virginia Erosion & Sediment Control Law (Law) and Erosion and Sediment Control (ESC) Program implementation.

Land-Disturbing Activity means "any land change which may result in soil erosion from water or wind and the movement of sediments into state waters or onto lands in the Commonwealth, including, but not limited to, clearing, grading, excavating, and transporting, and filling of land." The Law is intended to regulate land-disturbing activities exceeding 10,000 square feet in area; however, the thirteen activities briefly listed below are specifically exempt from the definition:

1. Minor land-disturbing activities and individual home landscaping, repairs, and maintenance work;
2. Individual service connections;
3. Installation, maintenance, or repair of any underground public utility lines when such activity is confined to an existing hard surfaced road, street, or sidewalk;
4. Septic tank lines or drainage fields unless included in an overall plan for land-disturbing activity relating to construction of the building to be served by the septic tank system;
5. Surface or deep mining;
6. Exploration or drilling for oil and gas including the well site, roads, feeder lines and off-site disposal areas;
7. Tilling, planting, or harvesting of agricultural, horticultural, or forest crops, or livestock feedlot operations; including a specific list of engineering operations;
8. Repair or rebuilding of the tracks, right-of-way, bridges, communication facilities and other related structures, and facilities of a railroad company;
9. Agricultural engineering operations including but not limited to the construction of terraces, terrace outlets, check dams, desilting basins, dikes, ponds not required to comply with the provisions of the Dam Safety Act, ditches, strip cropping, lister furrowing, contour cultivating, contour furrowing, land drainage, and land irrigation;
10. Disturbed land areas of less than 10,000 square feet in size; however, the governing body of the local program authority may reduce this exception to a smaller area of disturbed land or qualify the conditions under which this exception shall apply;
11. Installation of fence, sign, telephone, electric, or other kinds of post or poles;

12. Shore erosion control projects on tidal waters when the projects are approved by local wetlands boards, the Marine Resources Commission or the United States Army Corps of Engineers; and
13. Emergency work to protect life, limb or property, and emergency repairs;

Erosion and Sediment Control Program means the program administered by the Board, DCR, or a locality pursuant to the Law. The ESC Program includes an outline of the various methods employed by a program to regulate land-disturbing activities and thereby minimize erosion and sedimentation in compliance with the Law. This may include such items as local ordinances, administrative policies and guidelines, technical materials, plan review, inspection, and enforcement provisions.

Erosion and Sediment Control Plan means a document containing material for the conservation of soil and water resources of a unit or group of units of land. It may include appropriate maps, an appropriate soil and water plan inventory and management information with interpretations, and a record of decisions contributing to conservation treatment. The plan shall contain all ESC specifications (also referenced herein as "measures") and major conservation decisions to assure that the entire unit or units of land will be so treated to achieve the conservation objectives.

Agreement in lieu of a plan means a contract between the plan-approving authority and the owner which specifies conservation specifications which must be implemented in the construction of a single-family residence; this contract may be executed by the plan-approving authority in lieu of a formal site plan.

Owner means the owner or owners of the premises on which a regulated land-disturbing activity is undertaken. The owner is responsible for the preparation, submission, approval, and implementation of the ESC plan. The owner is further ultimately responsible for resolving any enforcement actions or damages associated with the activity.

Applicant/Permittee means the applicant or permittee who may be the owner or an agent empowered by the owner to seek plan approval or obtain any required permits.

Responsible Land Disturber (RLD) means an individual holding a certificate of competence issued by DCR who will be in charge of and responsible for carrying out the land-disturbing activity in accordance with the approved plan. The RLD may be the owner, applicant, permittee, designer, superintendent, project manager, contractor, or any other project or development team member. The RLD must be designated on the plan or permit as a prerequisite for plan approval by the Plan-Approving Authority.

Program Authority means an ESC Program operated by DCR, a district, or a locality that has been approved by the Virginia Soil and Water Conservation Board (Board). The Program Authority is responsible for overall administration of an ESC program, including provision of periodic site inspections and issuance of enforcement action to ensure proper plan implementation. The Plan-Approving Authority may assist the local program with project inspection.

Plan-Approving Authority means the Board, Soil and Water Conservation District, Program Authority, or a department of a Program Authority, responsible for review and approval of plans and issuance of required permits. The Plan-Approving Authority must ensure that an RLD has been properly designated prior to plan approval.

DISCUSSION OF REGUALTED LAND-DISTURBING ACTIVITIES

Below is clarification of the exempt status of certain types of land-disturbing activities that have raised question in the past:

1. Activities Disturbing Less Than 10,000 square feet: Activities that disturb less than 10,000 square feet are exempt; however, this limit may be reduced by a locality. This threshold may not be increased. Resource areas designated under the Chesapeake Bay Preservation Act must regulate activities that exceed 2,500 square feet.

2. Home Landscaping and Maintenance Work: This exemption refers only to "minor" land-disturbing activities associated with home ownership. However, it does not apply to clearing operations in excess of 10,000 square feet (or 2,500 square feet in Bay Act areas).

3. Agricultural Activities: The only agricultural activities that are exempt involve the tilling, planting, or harvesting of agricultural, horiticultural, or forest crops, or feedlot operations, including a list of specific engineering operations that support these specific activities. Note that this exemption will not apply to harvesting or forest crops unless the area on which harvesting occurs is reforested artificially or naturally or is converted to bona fide agricultural or improved pasture use in accordance with the Forestry Code (Title 10, Chapter 11, Section 1100 et. Seq.). The construction of farmhouses, barns, livestock/poultry houses, stables, silos, and green houses are not exempt. The construction of roads is exempt if the roads are deemed necessary for tilling, planting, or harvesting operations.

4. Single Family Homes: The construction of homes on subdivision lots is not exempt even if the land disturbance on the single lot is less than 10,000 square feet. The disturbance associated with the entire subdivision is considered in total. The Law states that localities may use an agreement in lieu of a plan in place of a formal erosion and sediment control plan for these lots. Agreements should not be used automatically for all single family construction. Site-specific conditions, such as critical slopes, highly erodible soils, and other parameters, may necessitate a full erosion and sediment control plan.

5. Utilities: Utility activities that are exempt include: (1) individual service connections; (2) installation, maintenance, or repair of underground public utility lines when such activity occurs on an existing hard surfaced road, street or sidewalk if the activity is confined to the area of the road, street, or sidewalk; and (3) installation of telephone or electric post or poles. Construction, installation, and maintenance activities undertaken by private and public electric, communication, and natural gas entities are required to file general erosion and sediment control specifications annually with DCR for review and approval on behalf of the Virginia Soil and Water Conservation Board. Section 10.1-563D of the Law discusses this specifications requirement. Municipal water and sewer construction projects must seek approval of an erosion and sediment control plan from the local erosion and sediment control program.

6. Railroads: Repair or rebuilding of the tracks, right-of-way, bridges, communication facilities, and other related structures, and facilities of a railroad are exempt from the Law. However, new construction of these same items must comply with the provisions of the Law by filing general erosion and sediment control specifications annually with the DCR for review and

approval on behalf of the Virginia Soil and Water Conservation Board. Section 10.1-563D of the Law discusses this requirement.

7. Mining and Drilling: The Law does not regulate surface or deep mining of coal or other mineral resources or exploration or drilling for gas or oil including the well site, roads, feeder lines, and off site disposal areas. These activities are subject to rules established under the Department of Mines, Mineral, and Energy (DMME) and applicable federal regulations.

8. Shore Erosion Control Projects: Shoreline erosion control projects in tidal waters are exempt provided they are approved by local wetlands boards, the Virginia Marine Resources Commissions (VMRC), the Virginia Department of Environmental Quality (DEQ), or the U.S. Army Corp of Engineers. These projects must comply with any permit requirements for conserving natural resources issued by these regulating agencies. VMRC coordinates the Joint Permit Application process for projects operating in state waters and wetlands.

PROGRAM AUTHORITY FOR PRIVATE AND PUBLIC PROJECTS

The Law indicates that the Program Authority for a specific land-disturbing activity is dictated by who owns the land on which an activity will be undertaken. The discussion below outlines the four basic types of projects and the government entity who serves as the regulatory authority.

1. Private: Land-disturbing activities on **private lands** must be covered by an ESC plan approved by the locally operated ESC Program in the jurisdiction in which activity is undertaken. As previously mentioned, municipal water and sewer construction projects are regulated at the local level. The local ESC Program is responsible for program administration, plan review and approval, site inspection, complaint response, and enforcement on these projects.

2. Multi-jurisdictional: Land-disturbing activities that cross local jurisdictions may be regulated at either the local or state level. The applicant has the option of submitting the ESC plan to each locality involved, or to DCR. Inspection and enforcement is generally carried out at the local level.

3. State: Construction projects on **state agency land** must be covered by an ESC plan or annual specifications approved by DCR. Plans must be consistent with local requirements that are more stringent than the state program. DCR is responsible for plan review and approval, site inspection, complaint response, and enforcement on these projects.

4. Federal: Construction projects on **federal lands** must comply with the Law and applicable federal nonpoint source pollution programs on all regulated land disturbing activities in the Commonwealth. The Law gives the Virginia Soil and Conservation Board and local ESC programs the authority to cooperate and enter into agreements with federal agencies to facilitate ESC compliance. As with state projects, plans must be consistent with local requirements that may be more stringent than the state program. The federal agency is responsible for achieving compliance through separate agreements/contracts with on site developers, regular field inspection, prompt enforcement action against non-compliant projects, and/or other mechanisms consistent with agency policy.

MINIMUM STANDARDS

All regulated land-disturbing activities must comply with the 19 Minimum Standards (MS) specified in Section 4VAC50-30-40 of the Virginia Erosion and Sediment Control Regulations (Regulations) that are applicable to the specific project. All ESC Programs are required to confirm that projects are compliant with the criteria, techniques, and policies outlined in the Minimum Standards. An ESC program may waive or modify any of the Minimum Standards that are deemed inappropriate or too restrictive for site conditions by granting a written variance. The 19 Minimum Standards are listed below:

MS-1 Permanent or temporary soil stabilization shall be applied to denuded areas within seven days after final grade is reached on any portion of the site. Temporary soil stabilization shall be applied within 7 days to denuded areas that may not be at final grade but will remain dormant for longer than 30 days. Permanent stabilization shall be applied to areas that are to be left dormant for more than one year.

MS-2 During construction of the project, soil stockpiles and borrow areas shall be stabilized or protected with sediment trapping measures. The applicant is responsible for the temporary protection and permanent stabilization of all soil stockpiles on site as well as borrow areas and soil intentionally transported from the project site.

MS-3 A permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized. Permanent vegetation shall not be considered established until a ground cover is achieved that is uniform, mature enough to survive, and will inhibit erosion.

MS-4 Sediment basins and traps, perimeter dikes, sediment barriers and other measures intended to trap sediment shall be constructed as a first step in land-disturbing activity and shall be made functional before upslope land disturbance takes place.

MS-5 Stabilization measures shall be applied to earthen structures such as dams, dikes, and diversions immediately after installation.

MS-6 Sediment traps and sediment basins shall be designed and constructed based upon the total drainage area to be served by the trap or basin.

a. The minimum storage capacity of a sediment trap shall be 134 cubic yards per acre of drainage area, and the trap shall only control drainage areas less than three acres.
b. Surface runoff from drainage areas greater than or equal to three acres shall be controlled by sediment basins. The minimum storage capacity for a sediment basin shall be 134 cubic yards per acre of drainage area. The outfall system shall, at a minimum, maintain the structural integrity of the basin during a twenty-five year storm of 24-hour duration. Runoff coefficients used in runoff calculations shall apply to a bare earth condition or those conditions expected to exist while the sediment basin is utilized.

MS-7 Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion. Slopes that are found to be eroding excessively within one year of permanent stabilization shall be provided with additional slope stabilizing measures until the problem is corrected.

MS-8 Concentrated runoff shall not flow down cut or fill slopes unless contained within an adequate temporary or permanent channel, flume, or slope drain structure.

MS-9 Whenever water seeps from a slope face, adequate drainage or other protection shall be provided.

MS-10 All storm sewer inlets that are made operable during construction shall be protected so that sediment-laden water cannot enter the conveyance system without first being filtered or otherwise treated to remove sediment.

MS-11 Before newly constructed stormwater conveyance channels or pipes are made operational, adequate outlet protection and any required temporary or permanent channel lining shall be installed in both the conveyance channel and receiving channel.

MS-12 When work in a live watercourse is performed, precautions shall be taken to minimize encroachment, control sediment transport, and stabilize the work area to the greatest possible extent during construction. Non-erodible material shall be used for the construction of causeways and cofferdams. Earthen fill may be used for these structures if armored by non-erodible cover materials.

MS-13 When a live watercourse must be crossed by construction vehicles more than twice in any six-month period, a temporary vehicular stream crossing constructed of non-erodible material shall be provided.

MS-14 All applicable federal, state, and local regulations pertaining to working in or crossing live watercourses shall be met.

MS-15 The bed and banks of a watercourse shall be stabilized immediately after work in the watercourse is completed.

MS-16 Underground utility lines shall be installed in accordance with the following standards in addition to other applicable criteria:

a. No more than 500 linear feet of trench may be opened at one time.
b. Excavated material shall be placed on the uphill side of trenches.
c. Effluent from dewatering operations shall be filtered or passed through an approved sediment trapping device, or both, and discharged in a manner that does not adversely affect flowing streams or off-site property.
d. Material used for backfilling trenches shall be properly compacted in order to minimize erosion and promote stabilization.
e. Re-stabilization shall be accomplished in accordance with these regulations.
f. Applicable safety regulations shall be complied with.

MS-17 Where construction vehicle access routes intersect paved or public roads, provisions shall be made to minimize the transport of sediment by vehicular tracking onto the paved surface. Where sediment is transported onto a paved or public road surface, the road surface shall be cleaned thoroughly at the end of each day. Street washing shall be allowed only after sediment is removed in this manner. This provision shall apply to individual development lots as well as to larger land-disturbing activities.

MS-18 All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization or after the temporary measures are no longer needed, unless otherwise authorized by the local program. Trapped sediment and disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.

MS-19 Properties and waterways downstream from development sites shall be protected from sediment deposition, erosion, and damage due to increases in volume, velocity, and peak flow rate of stormwater runoff for the stated frequency storm of 24-hour duration in accordance with the following standards and criteria:

a. Concentrated stormwater runoff leaving a development site shall be discharged directly into an adequate natural or man-made receiving channel, pipe, or storm sewer system. For those sites where runoff is discharged into a pipe or pipe system, downstream stability analyses at the outfall of the pipe or pipe system shall be performed.
b. Adequacy of all channels and pipes shall be verified in the following manner:
    i. The applicant shall demonstrate that the total drainage area to the point of analysis within the channel is one hundred times greater than the contributing drainage area of the project in question; or
    ii. (a) Natural channels shall be analyzed by the use of a two-year storm to verify that stormwater will not overtop channel banks nor cause erosion of channel bed or banks; and
    (b) All previously constructed man-made channels shall be analyzed by the use of a ten-year storm to verify that stormwater will not overtop its banks and by the use of a two-year storm to demonstrate that stormwater will not cause erosion of channel bed or banks; and
    (c) Pipes and storm sewer systems shall be analyzed by the use of a ten-year storm to verify that stormwater will be contained within the pipe or system.
c. If existing natural receiving channels or previously constructed man-made channels or pipes are not adequate, the applicant shall:
    i. Improve the channel to a condition where a ten-year storm will not overtop the banks and a two-year storm will not cause erosion to the channel bed or banks; or
    ii. Improve the pipe or pipe system to a condition where the ten-year storm is contained within the appurtenances; or
    iii. Develop a site design that will not cause the pre-development peak runoff rate from a two-year storm to increase when runoff outfalls into a natural channel, or will not cause the pre-development peak runoff rate from a ten-year storm to increase when runoff outfalls into a man-made channel; or
    iv. Provide a combination of channel improvement, stormwater detention, or other measures to prevent downstream erosion satisfactory to the plan-approving authority.
d. The applicant shall provide evidence of permission to make the improvements.

e. All hydrologic analyses shall be based on the existing watershed characteristics and the ultimate development of the subject project.
f. If the applicant chooses an option that includes stormwater detention, he shall obtain approval from the locality of a plan for maintenance of the detention facilities. The plan shall set forth maintenance requirements of the facility and designate the person responsible for performing the maintenance.
g. Outfall from a detention facility shall be discharged to a receiving channel, and energy dissipaters placed at the outfall of the detention facilities as necessary to provide a stable transition from the facility to the receiving channel.
h. All on-site channels must be verified to be adequate.
i. Increased volumes of sheet flows causing erosion or sedimentation on adjacent property shall be diverted to a stable outlet, adequate channel, pipe or pipe system, or to a detention facility.
j. In applying these stormwater runoff criteria, individual lots or parcels in a residential, commercial, or industrial development shall not be considered to be separate development projects. Instead, the development as a whole shall be treated as a single project. Hydrologic parameters that reflect the ultimate development state shall be used in all engineering calculations.
k. All measures used to protect properties and waterways shall be executed in a manner that minimizes the impact on the physical, chemical, and biological integrity of rivers, streams, and other state waters.

PRINCIPLES AND PRACTICES SECTION

LEARNING OBJECTIVE

1. To understand the basic **principles** of erosion and sedimentation.
2. To understand the seven **practices** that are essential to successful implementation of erosion and sediment controls on construction sites.
3. To understand the inspection responsibilities of the RLD during active construction.

INSTRUCTIONAL ELEMENTS

GUIDING PRINCIPLES

There are three overriding principles of erosion and sediment control (ESC) that provide the basis for all planning and design work. These should form the basis for each development project. The three principles are:

1. Erosion control
2. Sediment Control
3. Coordination

Erosion control is the first line of defense; if there is no erosion, there can be no sediment. Control at the source of material prevents both erosion damages and sediment damages. In some instances, this may be the only way to have an acceptable level of control of the very fine sediments. In many instances, in field situations, it will be impossible or impractical to impound water laden with this fine material for long enough periods for it to settle out.

Sediment control is the second line of defense. It provides a backup when all possible erosion control measures have been utilized. Sediment should be filtered out of the runoff water or allowed to settle out before the runoff leaves the site. Care must be taken so that runoff released from the site will not cause channel erosion and sediment damage downstream.

These lines of defense must be coordinated to achieve the most effective level of protection. This calls for coordination of erosion and sediment control operations and coordination of these with the overall plan for the development. Erosion control will seldom, if ever, be completely effective during construction. Adequate provisions for trapping sediment before it leaves the site must back up erosion control. To prevent downstream damages, an evaluation must be made to determine what is needed to counteract the higher runoff that will occur after development. Facilities should be provided to reduce the damages that might otherwise occur. Erosion and sediment control must be planned along with the total plan for the site. If this is not done during or along with the planning for the total development, the land developer will be left with limited, costly, and unsatisfactory options for erosion and sediment control.

GEOLOGIC vs. ACCELERATED EROSION

Soil erosion is usually defined as the wearing away of the land surface by water, wind, ice, and gravity. In Virginia, we are primarily concerned with erosion by water. For our purposes, we can define soil erosion as a process of detachment and transportation of soil materials by erosive agents.

Erosion is not a recent phenomenon. It has been occurring since the beginning of time. Whole mountains have eroded away. Sediment deposits several miles thick have been formed. Features as spectacular as the Grand Canyon have resulted from erosion. This natural process is called geologic erosion. It seldom is discernible to us. It usually continues as a slow natural process unless it is disturbed by the activities of man. Geologic erosion produces about 30% of the total sediment in the U.S.

The erosion about which we are more concerned results from man's use of the land. This type is called accelerated erosion since the geologic rate is increased by the intervention of man. In this country, accelerated erosion began when the first settlers from Europe cleared sloping land and planted soil-exposing crops. Accelerated erosion accounts for about 70% of all the sediment produced in the U.S.

Surface mining, forestry, agriculture, and construction are the major activities causing accelerated erosion. About 71% of the sediment generated by accelerated erosion comes from agricultural land. Cropland is the chief source of this sediment. Construction activities, surface mining, forestry, and stream channel erosion account for the remaining 29%. Indirect effects of construction may be resulting in much higher sediment production than the direct activities. Stormwater runoff from impervious surfaces in urban areas is causing many streams that were relatively stable to suffer severe channel erosion.

THE FIVE TYPES OF EROSION

Raindrop erosion is the first effect of a rainstorm on the soil. Raindrop impact dislodges soil particles and splashes them into the air. These detached particles are then vulnerable to sheet erosion.

Sheet erosion is the erosion caused by a shallow sheet of water as it runs off the land. These very shallow, moving sheets of water are seldom the detaching agent, but the flow transports soil particles that are detached by raindrop impact and splash. The shallow surface flow rarely moves as a uniform sheet for more than a few feet on land surfaces before concentrating in surface irregularities.

Rill erosion is the erosion that develops as the shallow surface flow begins to concentrate in the low spots of the irregular conformation of the surface. As the flow changes from shallow sheet flow to deeper flow in these low areas, the velocity and turbulence of flow increase. The energy of this concentrated flow is able to both detach and transport soil materials. This action begins to cut tiny channels of its own. Rills are small but well-defined channels that are, at the most, only a few inches deep. They are easily obliterated by harrowing or other surface treatments, and have no more than 1 square foot cross-section.

Gully erosion occurs as the flow in rills comes together in larger and larger channels. The major difference between gully and rill erosion is size. Gullies are too large to be repaired with conventional tillage equipment and usually require heavy equipment and special techniques for stabilization.

Channel erosion occurs as the volume and velocity of flow cause movement of the stream bed and bank materials.

FACTORS INFLUENCING EROSION

There are four major factors which have a direct influence on the detachment and transportation of soil materials. These are:

1. Climate
2. Soils
3. Topography
4. Vegetation (or surface cover)

Climate

We will first discuss climate since it is the source of the major erosive agent in the erosion process. When we talk about climate we are primarily concerned with rainfall, although temperature and snow cover are also important. The discussion of rainfall can be divided into the effects of raindrops and the effects of runoff.

Raindrop erosion is the first step in the erosion process. The action of falling rain is responsible for 90% or more of total soil erosion. It produces two damaging effects: the detachment and transportation of surface soil and the puddling or sealing of the soil surface. Neutralizing these two effects is the first and most important part of erosion control.

How can rainfall be responsible for so much damage? Observations of a hard rain on bare soil confirm its destructive power. The drops hit the surface like tiny bombs. They shatter soil granules and splash the detached material back and forth. Splashed particles may be moved more than two feet high and five feet horizontally. On level land, this is self-canceling. On sloping land, the net movement is downhill. On a 10% slope, 75% of the soil movement is downslope. More than 100 tons of soil per acre may be detached in a single rain.

The erosive capacity of rainfall comes from the energy of its motion, or kinetic energy. It is dependent upon the amount and intensity of rainfall, raindrop diameter, and raindrop velocity.

Drop size varies from the finest mist to drops which are 1/3 inch in diameter. Any rain will contain drops of various sizes. A hard rain has a much higher proportion of large drops.

Raindrop velocity is tied very closely to drop size. Fine mists with droplets of about 1/100 inch diameter fall at a rate of about 1 inch per second. The largest drops attain a velocity of 30 feet per second. It is obvious from this that rain falling as large drops in a hard thunderstorm has many times more erosive capacity than that falling as fine drizzle over a longer period of time. The actual force of raindrop impact in a hard summer storm may be 2 or 3 hundred times the force of the surface runoff, even on steep slopes.

The effects of splash erosion are easy to see in nature. Splashed soil particles can be seen clinging to the foundation of buildings that are adjacent to bare soil. Particles can be seen on stems and leaves of plants that are growing in a partially vegetated field. Pedestals of soil, capped with protective stones, can be seen where raindrop splash carried away unprotected material.

Another important aspect of rainfall is its distribution. The most erosive rains are not scattered evenly throughout the year. In Virginia, they are concentrated in the months of June through September.

Unfortunately, this period of most erosive rain coincides with the most active part of the construction season.

Table 1 indicates some significant differences between storms occurring during the spring and summer and those occurring in the fall and winter.

TABLE 1
PRECIPITATION CHARACTERISTICS BY SEASON

CHARACTERISTICS	SEPT – APRIL	MAY – AUGUST
Form	Rain and Snow	Rain
Intensity	Low	High
Drop Size	Small	Large
Duration of Storm	Long	Short
Area of Storm	Large	Small

So far we have concentrated on the force of falling rain and its capacity to detach and move soil material. Another damaging effect of raindrops is the compacting, puddling, and sealing of the soil surface. As mentioned before, large drops strike with tremendous impact, compacting the soil under the point of impact. Repeated strikes churn the surface into a slurry. As this semi-fluid mass attempts to infiltrate the soil, it does a very effective job of sealing the pore spaces against further entry of water. As drops continue to beat against the surface, they sort and compact the material until an almost complete seal is formed. Even on coarse sands, this action reduces the intake of water.

This brings us to the other damaging aspect of rainfall-runoff. Runoff begins when the rate of rainfall exceeds the intake capacity of the soil. When a hard rainfall is unimpeded as it strikes the soil, runoff begins a few minutes after the start of the rain. In the early stages, its major potential for damage is as a transporting agent for soil dislodged by raindrop splash. As water begins to collect on the surface, it has no kinetic energy. It derives energy from its movement as it begins to run downslope. The amount of runoff depends on two things: the amount and intensity of the rainfall, and the nature of the soil or intervening surface that it falls upon. Runoff at first takes the form of a layer of water flowing more or less uniformly over the ground. Depth of this flow is usually very shallow. Flows of this sort have practically no capacity to detach soil, but they do have the capacity to transport particles that are detached and kept in suspension by raindrop impact. The result of this combination of the detaching capacity of raindrops and the transporting capacity of sheet-flow runoff is sheet erosion. The effects of this type of erosion occur on all parts of the land surface except in rills and gullies. Because it removes soil in thin layers from 95% or more of the land surface, it is difficult to observe, even though the total soil loss may be tremendous.

Under normal field conditions, runoff occurs both as sheet flow and channel flow. As water moves downslope, it tends to follow the path of least resistance. The flow begins to concentrate in the depressions and irregularities of the land surface. This is the beginning of channel flow. As the amount of water in these channels increases, the velocity and turbulence also increases. As the runoff concentrates first in tiny channels then combining into larger and larger ones, it gains the force to both detach and transport soil material. The erosive capacity of flowing water is based upon its velocity, turbulence, the amount and type of abrasive material flow, the roughness of the channel, and the slope gradient. As the length of slope increases, the depth, and hence the velocity, also increases.

Detachment by flowing water is confined primarily to the areas of concentrated flow (rills and gullies). Rolling, lifting, and abrasive actions influence the detachment of soil particles. The force is horizontal, in the direction of the flow. The flow force detaches particles by rolling or dragging them out of position. As velocity and turbulence increase, vertical currents and eddies occur. This upward movement of water lifts soil particles from their place and sets them in motion. As the particles of soil already transported by the flow strike or drag over other soil particles, they detach them and set them in motion. This is detachment by abrasive action. The amount and abrasiveness of the flow particles influences the amount of soil detached by abrasion.

The same factors that determine detaching capacity act to determine the transporting capacity. As mentioned before, sheet flow has very little detaching capacity. It is effective in transporting soil materials because raindrop impact keeps the material in suspension. It has been observed that muddy water flowing across a parking lot leaves a deposit of mud under each car while the adjacent pavement is washed clean. In this case, the velocity and turbulence of flow alone is not enough to keep the material in suspension. The material detached by raindrops and transported by sheet flow is the more finely textured soil material.

The flow in rills and gullies transports material by "surface creep," "saltation," and suspension. In surface creep, the particles roll or slide along the bottom of the rill or gully. The particles move by saltation when the uneven forces of turbulence lift and move them by jumps. Particles travel in suspension when the upward velocities of turbulent flow exceed the gravitational weight of the soil material. In general, larger particles are moved by surface creep and saltation while smaller particles are moved by suspension. Unless limited by the amount that can be detached, the total amount of material moved depends on the transportation capacity of the runoff and the transportability of the soil material.

Soil

The second major factor influencing erosion is the soil. When all other factors are held constant, different kinds of soil erode at different rates. Soil differences may cause more than a tenfold difference in erosion rates. The difference in erosion rates that is due to the properties of the soil itself is called soil erodibility.

The soil properties that influence erodibility by water are: (1) those properties that affect the rate at which water enters the soil (infiltration rate), (2) properties that affect the rate at which water moves through the soil (permeability), (3) the total water volume, (4) factors affecting detachment by raindrop impact and detachment by rolling, lifting, and abrasion of flowing water, and (5) characteristics of the soil that allow it to resist the transporting forces of rainfall and runoff.

Soil erodibility has been investigated intensively in development of the Universal Soil Loss Equation. The important properties are: (1) particle size and gradation, (2) percent of organic matter, (3) soil structure, and (4) soil permeability. There are several additional properties that influence soil erodibility, but the above account for approximately 85% of the variance in observed soil loss.

There is a very good correlation between erodibility and an index derived from five soil parameters. Two of these reflect particle size and gradation while the other three are percent organic matter, soil structure, and soil permeability.

Soil particle size distribution plays a major role in determining erodibility. Erodibility tends to increase with increased silt and very fine sand content; and to decrease with increased sand, clay, and organic matter content. Soils with a high clay content are generally more resistant to detachment,

although once detached, the clay particles are easily transported. Clay also usually has poor infiltration, thus increasing runoff. An increase in organic matter reduces erodibility by improving structure and the stability of structure. Organic matter also improves permeability.

To the RLD and inspector, who are likely to be laymen in the field of soils, a good indicator of how badly a soil can be expected to erode is its erodibility factor (K). These soil erodibility factors were developed for an equation, the Universal Soil Loss Equation, that predicts soil loss. If the name of a particular soil is known, its erodibility factor can be researched in Appendix 6C of the 1992 *Virginia Erosion and Sediment Control Handbook*. The greater the K factor, the greater the soil's erodibility. K factors are grouped into three ranges:

1. 0.23 and lower – low erodibility
2. 0.24 – 0.36 – moderate erodibility
3. 0.37 and higher – higher erodibility

It is a good idea to inventory the soils on a site before beginning construction to identify the areas with highly erodible areas. Assistance in soil identification is available from the local USDA Natural Resource Conservation Service office.

Topography

In the two topics discussed thus far, we have covered the causes of water erosion. We have been concerned with the power of rain to erode soil and the resistance or susceptibility of soil to water erosion. The remaining two topics, "Topography" and "Surface Cover," discuss factors that may modify water erosion.

In terms of erosion, slope characteristics are the most important part of site topography. These characteristics include steepness, length, contour, and slope direction. Slope length is the distance from the point where overland flow begins to the point where it becomes a well-defined waterway (or soil deposition location) resulting from a reduction in slope grade. The longer the slope, the greater the runoff depth. As water descends a slope, its velocity and channel depth increases. As a general rule, erosion risk becomes critical when slope length exceeds the following values:

Slope Gradient	Slope Length
0-7%	300 feet
7-15%	150 feet
15% and over	75 feet

Slope steepness influences erosion in several ways. Steep slopes tend to increase the incidence of downhill splash. Moreover, flow velocity and runoff increase proportionate to slope steepness. Slope gradients are grouped into three risk categories:

0-7%	Low Erosion Risk
7-15%	Moderate Erosion Risk
15% & over	High Erosion Risk

The shape of slopes can affect erosion. On convex slopes (slopes which steepen at the lower end) the erosion potential is greater. On concave slopes (slopes that flatten at the lower end) the erosion potential will be less.

Direction of slope has an indirect effect simple because of the effect that exposure has on vegetation. South and southwest facing slopes are usually the hardest to vegetate and maintain when all other slope factors are considered to be equal.

Surface Cover

Surface cover is the last of the four factors influencing erosion. IT IS PERHAPS THE MOST IMPORTANT FACTOR FROM THE STANDPOINT OF CONTROL. Research has shown that the amount of erosion is proportionate to the amount of bare soil that is exposed to raindrop impact. The use of vegetation, mulches, and other surface covers offers the greatest range of control alternatives.

One further value of vegetation is its effect on runoff velocity. Certain types of vegetation are known to be very effective in reducing erosion caused by flowing water. Vegetation is frequently used to provide a protective lining in shallow waterways.

IMPLEMENTATION OF EROSION AND SEDIMENT CONTROLS

The following section breaks down the implementation of an erosion and sediment control plan into seven practices, primarily from the perspective of the Responsible Land Disturber (RLD). The seven practices are:

1. Site Review
2. Pre-Construction Conference
3. Site Preparation
4. Inspection and Maintenance
5. Grading and Utilities Installation
6. Building Construction
7. Permanent Site Stabilization

Site Review

The RLD must be thoroughly familiar with both the existing conditions at the construction site and the approved ESC plan for the land-disturbing activity.

The RLD should note all existing critical areas indicated on the plan and then actually identify their location and extent on the ground. These should include stream channels and associated flood plain areas, drainage ways and outlets into streams, points where land-disturbing activities are adjacent to or must cross steams and drainage ways, steep slopes and highly erodible soils, and runoff entering the site from adjacent areas. The RLD should note what practices are specified to protect these areas. Also, he or she should be aware of critical areas not specifically treated in the plan. These issues should be discussed at the pre-construction conference with the contractors, consultants, and other appropriate parties who will be operating on site.

Next, the RLD should determine the location of all control measures and determine their appropriateness for existing site conditions and the planned project. The RLD should document any needed plan modifications and discuss these at the pre-construction conference.

Further, the RLD should check the schedule for the installation of erosion and sediment control (ESC) and their relationship with land-disturbing activities. The site must be protected as a first step before land-disturbing activities are started. Major land-disturbing activities should be phased in order to limit the size of denuded areas exposed at any time. The timing, sequence, and staging of control installations are important elements of the plan that should be assessed prior to the project initiation.

Pre-Construction Conference

Following review of the site, the RLD should set up a pre-construction conference and site review with on site contractors, consultants, and the inspector from the program authority. Attendance by the local inspector assigned to the site is essential to establish lines of communication early in the plan implementation process. Further, the site review will help all parties to fully understand their responsibilities prior to, during, and following active construction. All aspects of the plan and any suggested modifications and questions should be discussed to ensure that the RLD and all parties are in agreement regarding the plan and scheduling. Special attention should be given to perimeter practices designed to prevent damage to critical areas, adjacent properties, and/or natural resources.

The **location** of all measures should be carefully considered. If study of the plan indicates that adjustments in location are needed, these should be discussed with the RLD. The RLD may authorize minor adjustments, such as moving a diversion from a property line to a grading limit, or shifting an outlet to match a natural depression in the land. However, major adjustments may require formal revision of the plan and should be approved by the plan-approving authority.

The **sequence** and **phasing** of the installation of practices and land-disturbing activities should also be discussed. The guidelines for ESC planning require that sediment basins and other appropriate measures be installed prior to, or as a first phase of, land grading. Other appropriate measures include construction entrances, diversion dikes, interceptor dikes, perimeter dikes, gravel outlet structures, level spreaders, waterways or outlets, and grade stabilizing structures. The RLD must emphasize the importance of establishing these practices before grading begins.

The Minimum Standards should be checked to be sure that all applicable standards will be satisfied. A Minimum Standards Checklist may be used to quickly accomplish this task. Approved variances and associated formal documentation should be noted, and it should be determined if any additional measures or variances are needed.

Site Preparation

One of the first steps in preparing a site for active construction is to lay out all traffic circulation routes and storage areas. Route locations should be chosen so they pose the least threat to identified critical areas. Existing well-vegetated areas should be damaged as little as possible and soil stockpiles should be located a safe distance from waterways and streams. Barriers may be required to keep traffic within the delineated areas, or at least out of the critical areas. If needed, they should be installed before opening the site to general construction traffic.

Required structural sediment trapping practices should be installed and stabilized as a first step measure before general grading begins. (Note that compacting, seeding, and mulching are required to stabilize these practices.) Next, waterways and outlets should be installed with the vegetation or lining material called for in the plan.

The entire site work force should be instructed about the location of critical areas and associated ESC practices and the need to protect these areas from damage.

Inspection and Maintenance of ESC Specifications

Maintenance must begin as soon as the first temporary ESC specification is installed and must continue through all the succeeding activities until the permanent specifications or structures are established and functioning. The features of a maintenance program are described in the narrative part of the plan. All structural specifications should be checked at the close of each workday and before and after each rainstorm. Diversion berms should be checked to see that they have not been breached by equipment. The condition of level spreader areas, waterways, and other outlets should also be checked. Traffic should be moving within the established access routes. Perimeter controls and conveyance channels should be checked for sediment deposits or other impeding material. Repairs should always be made promptly when damages are discovered. When repairing waterways or other channels, the new lining material should be non-erosive. Vegetative practices and cover on structural practices require maintenance fertilizer and, perhaps, mowing on a regular basis.

All sediment traps and basins should be checked after each storm and cleaned out when the deposited material reaches the level designated in the plan.

Grading and Utility Construction

The fifth major step is site grading and utility installation. If stockpiling of fill or topsoil is planned, a pre-selected, relatively isolated stockpile area should be used. To minimize erosion, the slopes of the stockpile should be flattened at the end of each working period. The stockpile should be mulched and seeded if it's to remain dormant or is no longer needed.

Disturbed areas that can be brought to final grade at this stage during an appropriate season for seeding should be seeded, sodded, or otherwise stabilized with the permanent material and techniques indicated in the plan. If they cannot be seeded, they should be stabilized with anchored mulch or other appropriate stabilization measures. Areas to remain at rough grade for more than 30-days before permanent stabilization should be mulched and seeded to provide temporary cover within 7 days.

Utilities such as storm sewers, sanitary sewers, electric and communication lines, water mains, and gas mains are usually installed at this time. To minimize the amount of area disturbed, the work should be organized and the trenches sized to accommodate several utilities in one trench. The installation should be carefully coordinated to reduce the time that the trenches will stay open. Note that no more than 500 linear feet of trench may remain open at one time. If sediment-laden water must be pumped from utility trenches, it should be conveyed safely to an appropriate filtering measure (dewatering devices, sediment trap or basin). As soon as possible, trenches should be filled, compacted, mulched, and seeded to provide temporary or permanent stabilization. Further, as soon as the storm sewers are installed, inlet protection should be installed to prevent sediment from entering the system. If required, storm drain outlet protection should also be installed.

Building Construction

The sixth major step or stage is building construction. Two major hazards are common during this step. The introduction of additional equipment and work force brings added risks to areas requiring protection. Efforts to control traffic must be increased during this period. All traffic should be confined to established travel routes. The second hazard is from excavated material. This phase usually results in high volumes of soil for disposal and stockpiling. Stockpiles should be located where they will not wash into drainage ways or onto previously stabilized areas. The slopes on these areas should be flattened and

protected by anchored mulch and temporary seeding. Excavations should be backfilled as soon as possible, and appropriate surface protection and stabilization should be provided.

Permanent Site Stabilization

The last step is permanent stabilization. As mentioned earlier, this should not be delayed until the entire development is completed. A significant reduction in erosion damage repair and re-grading costs can be achieved if smaller areas are stabilized with permanent vegetation as soon as they are ready.

Most temporary sediment basins, dikes, sediment traps, and other earthen control structures are to be removed, re-graded, mulched, and seeded before leaving the site. However, the RLD should consult the plan before removing them to ensure that they are not removed until the surrounding area is stabilized and they are no longer needed.

In some cases, sediment basins, diversions, and waterways are to remain as part of the permanent stormwater runoff management system. In such cases, sediment basins should be cleaned out and seeded with suitable permanent vegetation. Diversions and waterways should be checked, repaired if needed, and left in good condition. The RLD should check on the final condition of permanent measures and confirm that long-term maintenance of these facilities is accounted for.

When final grading is completed, all denuded areas should be stabilized with permanent vegetation. The ESC specifications for permanent vegetative practices are provided in the Specifications Section.

PROJECT INSPECTION BY RESPONSIBLE LAND DISTURBER

The RLD should inspect the site frequently throughout the project, with careful inspection at installation of critical measures (e.g., sediment basins) and at the end of each phase for phased projects. The RLD will need to coordinate to ensure that appropriate parties (job superintendent, foreman, etc.) are available to participate in the inspection. Additionally, communication with the inspector from the Program Authority may also be required to coordinate on site visits. The RLD should be familiar with the plan and construction schedule ahead of time. Any required repairs or corrective actions indicated by the RLD should be made immediately. Any plan modifications recommended by the RLD should be discussed with the Owner and Plan-Approving Authority prior to implementation on site.

The RLD should also use a standard checklist when performing inspections. Most of the items on that checklist refer to a specific Minimum Standard (MS). The items from the checklist are listed below:

- ✓ Are there any denuded areas that require temporary or permanent stabilization? (MS-1)
- ✓ Are soil stockpiles adequately stabilized with seeding and/or sediment trapping measures? (MS-2)
- ✓ Does permanent vegetation provide adequate stabilization? (MS-3)
- ✓ Have sediment-trapping facilities been constructed as a first step? (MS-4)
- ✓ Are perimeter sediment trapping measures in place and earthen structures seeded and mulched? (MS-5)

- ✓ Have sediment basins been installed where needed? (MS-6)
- ✓ Are all cut and fill slopes adequately stabilized? (MS-7)
- ✓ Are all on-site drainage channels and outlets adequately stabilized? (MS-8&9)
- ✓ Are all operational storm sewer inlets protected so that sediment will not enter the system? (MS-10)
- ✓ Have stormwater conveyance channels been adequately stabilized? (linings and/or outlet protection) (MS-11)
- ✓ Is there any work going on in live streams that may require stabilization or a temporary stream crossing? (MS-12, MS-13, MS-14)
- ✓ Are utility trenches backfilled, seeded, and dewatered properly? (MS-16)
- ✓ Is there any evidence of dirt or mud the road? (MS-17)
- ✓ Are there any structural practices that should be removed because they are no longer needed? (MS-18)
- ✓ Do any structural practices require repair or clean-out to maintain adequate function? (MS-18)
- ✓ Are properties and waterways downstream from development adequately protected from erosion and sediment damage due to increases in peak stormwater runoff? (MS-19)

If violations of a plan or potentially hazardous situations are noted, they should be immediately reported to the Owner. The RLD may be able to suggest economical ways to achieve desirable corrections. In any case, it is wise to set a reasonable deadline for accomplishing necessary corrections. Plan changes or cases of non-compliance (such as commencing land disturbance without an approved plan) should be addressed with the Plan-Approving Authority and Program Authority as appropriate.

The common thread in any successful plan implementation is the need to reach timely solutions to issues that arise on site prior to and during plan implementation. By becoming knowledgeable in the Virginia ESC Program, developing a cooperative working relationship with on site parties, and exercising common sense, the RLD can facilitate efficient and economical plan implementation.

EROSION AND SEDUMENT CONTROL SPECIFICATIONS SECTION

LEARNING OBJECTIVE

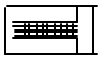
1. To become familiar with the description, construction details, and maintenance procedures for 25 erosion and sediment control specifications recommended by the Virginia ESC Program.

INSTRUCTIONAL ELEMENTS

This Section contains the description, construction details, and maintenance procedures for 25 of the most commonly applied structural and vegetative ESC specifications included in the *Virginia Erosion & Sediment Control Handbook* (Third Edition, 1992). The index below provides a list of the specifications covered in this Section.

ESC SPECIFICATIONS INDEX

STD. & SPEC. 3.02
TEMPORARY STONE CONSTRUCTION ENTRANCE



CE

Practice Description

A stabilized stone pad with a filter fabric underliner located at points of vehicular ingress and egress on a construction site, used to reduce the amount of mud transported onto paved public roads by motor vehicles or runoff.

Conditions Where Practice Applies

Wherever traffic will be leaving a construction site and moves directly onto a public road or other paved area.

Construction Specifications

1. Aggregate Size: VDOT #1 Coarse Aggregate (2- to 3- inch stone) should be used.

2. Entrance Dimensions: The aggregate layer must be at least 6 inches thick; a minimum three inches of aggregate should be placed in a cut section to give the entrance added stability and to help secure filter cloth separator. It must extend the full width of the vehicular ingress and egress area and have a minimum 12-foot width. The length of the entrance must be at least 70 feet (see Plate 3.02-1).

3. Washing: If conditions on the site are such that the majority of the mud is not removed by the vehicles traveling over the stone, then the tires of the vehicles must be washed before entering the public road. Wash water must be carried away from the entrance to an approved settling area to remove sediment. All sediment shall be prevented from entering storm drains, ditches, or watercourses. A wash rack may also be used to make washing more convenient and effective (see Plate 3.02-1).

4. Location: The entrance should be located to provide for maximum utilization by all construction vehicles.

5. The area of the entrance must be excavated a minimum of 3 inches and must be cleared of all vegetation, roots, and other objectionable material. The filter fabric underliner will then be placed the full width and length of the entrance.

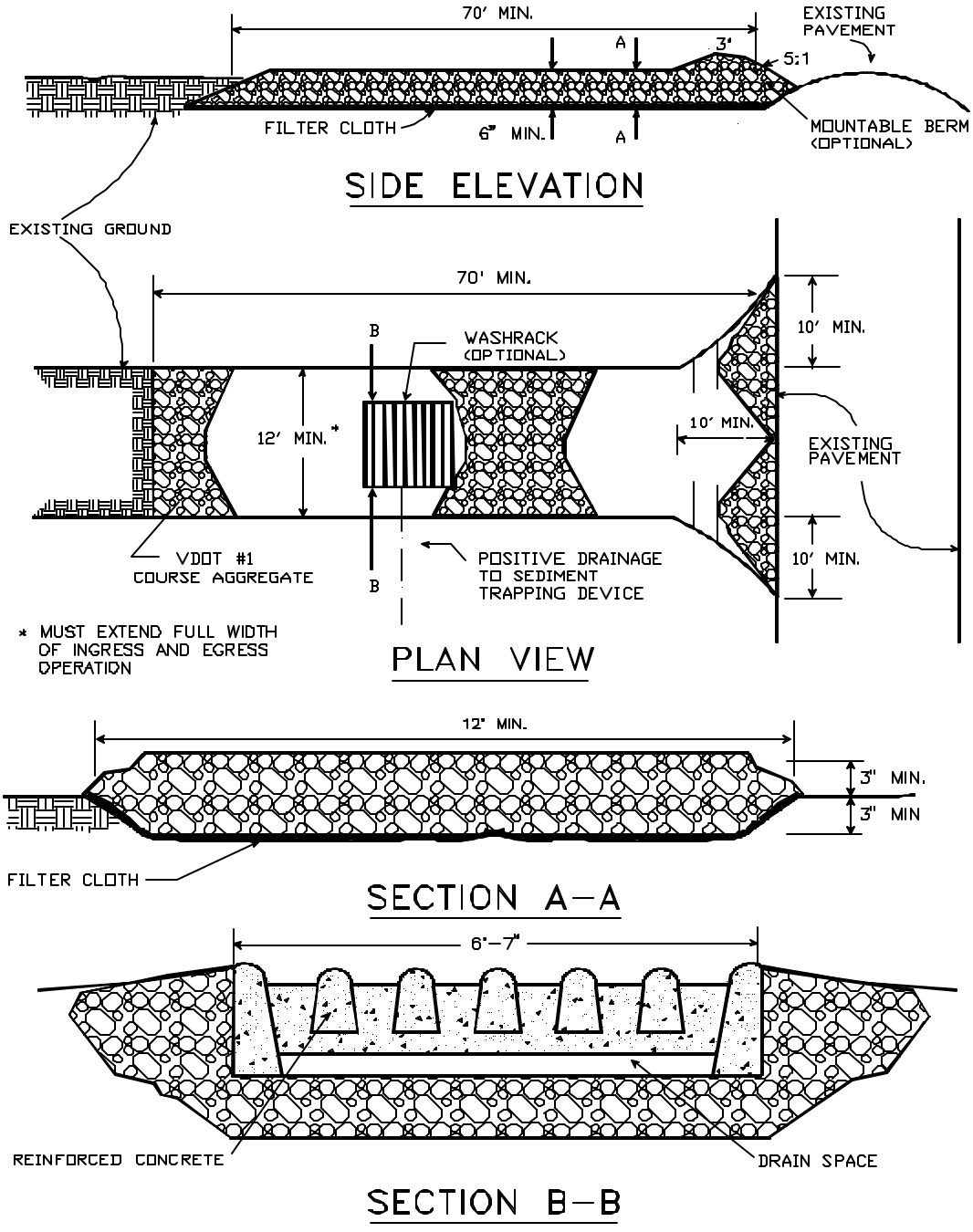
6. Following the installation of the filter cloth, the stone shall be placed to the specified dimensions. If wash racks are used, they should be installed according to manufacturer's specifications. Any drainage facilities required because of washing should be constructed according to specifications. Conveyance of surface water under entrance, through culverts, shall be provided as required. If such conveyance is impossible, the construction of a "mountable" berm with 5:1 slopes will be permitted.

The filter cloth utilized shall be a woven or nonwoven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals and hydrocarbons, be mildew and rot resistant.

Maintenance

The entrance shall be maintained in a condition that will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with additional stone or the washing and reworking of existing stone as conditions demand and repair and/or cleanout of any structures used to trap sediment. All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately. The use of water trucks to remove materials dropped, washed, or tracked onto roadways will not be permitted under any circumstances.

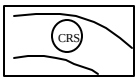
STONE CONSTRUCTION ENTRANCE



SOURCE: ADAPTED from 1983 Maryland Standards for Soil erosion and Sediment Control, and Va. DSWC

Plate 3.02-1

STD & SPEC 3.03
CONSTRUCTION ROAD STABILIZATION



CRS

Practice Description

The temporary stabilization of access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes with stone immediately after grading, to reduce the erosion of temporary roadbeds by construction traffic during wet weather, and to prevent having to regrade permanent roadbeds between the time of initial grading and final stabilization.

Conditions Where Practice Applies

Wherever stone-base roads or parking areas are constructed, whether permanent or temporary, for use by construction traffic.

Construction Specifications

Temporary Access Roads and Parking Areas

1. Temporary roads shall follow the contour of the natural terrain to the extent possible. Slopes should not exceed 10 percent.

2. Temporary parking areas should be located on naturally flat areas to minimize grading. Grades should be sufficient to provide drainage but should not exceed 4 percent.

3. Roadbeds shall be at least 14 feet wide for one-way traffic and 20 feet wide for two-way traffic.

4. All cuts and fills shall be 2:1 or flatter to the extent possible.

5. Drainage ditches shall be provided as needed and shall be designed and constructed in accordance with STORMWATER CONVEYANCE CHANNEL, Std. & Spec. 3.17.

6. The roadbed or parking surface shall be cleared of all vegetation, roots and other objectionable material.

7. A 6-inch course of VDOT #1 Coarse Aggregate shall be applied immediately after grading or the completion of utility installation within the right-of-way. Filter fabric may be applied to the roadbed for additional stability. Design specifications for filter fabric can be found within Std. & Spec. 3.02, TEMPORARY STONE CONSTRUCTION ENTRANCE. In "heavy duty" traffic situations (see Table 3.02-A), stone should be placed at an 8- to 10-inch depth to avoid excessive dissipation or maintenance needs.

Vegetation

All roadside ditches, cuts, fills and disturbed areas adjacent to parking areas and roads shall be stabilized with appropriate temporary or permanent vegetation according to the applicable standards and specifications contained in this handbook.

Maintenance

Both temporary and permanent roads and parking areas may require periodic top dressing with new gravel. Seeded areas adjacent to the roads and parking areas should be checked periodically to ensure that a vigorous stand of vegetation is maintained. Roadside ditches and other drainage structures should be checked regularly to ensure that they do not become clogged with silt or other debris.

STD & SPEC. 3.05
SILT FENCE

Practice Description

A temporary sediment barrier consisting of a synthetic filter fabric stretched across and attached to supporting posts and entrenched, used to intercept and detain small amounts of sediment from disturbed areas during construction operations in order to prevent sediment from leaving the site, and to decrease the velocity of sheet flows and low-to-moderate level channel flows.

Conditions Where Practice Applies

1. Below disturbed areas where erosion would occur in the form of sheet and rill erosion.

2. Where the size of the drainage area is no more than one quarter acre per 100 feet of silt fence length; the maximum slope length behind the barrier is 100 feet; and the maximum gradient behind the barrier is 50 percent (2:1).

3. In minor swales or ditch lines where the maximum contributing drainage area is no greater than 1 acre and flow is no greater than 1 cfs.

4. Silt fence will not be used in areas where rock or some other hard surface prevents the full and uniform depth anchoring of the barrier.

Construction Specifications

1. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier as conforming to the requirements noted in Table 3.05-B.

TABLE 3.05-B
PHYSICAL PROPERTIES OF
FILTER FABRIC IN SILT FENCE

Physical Property	Test	Requirements
Filtering Efficiency	ASTM 5141	75% (minimum)
Tensile Strength at 20% (max.) Elongation*	VTM-52	Extra Strength- 50 lbs./linear inch (minimum) Standard Strength- 30 lbs./linear inch (minimum)
Flow Rate	ASTM 5141	0.2 gal./sq. ft./min. (minimum)
Ultraviolet Radiation	ASTM-G-26	90% (minimum)

*Requirements reduced by 50% after six months of installation.

Source: VHTRC

2. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0? F to 120? F.

3. If wooden stakes are utilized for silt fence construction, they must have a diameter of 2 inches when oak is used and 4 inches when pine is used. Wooden stakes must have a minimum length of 5 feet.

4. If steel posts (standard "U" or "T" section) are utilized for silt fence construction, they must have a minimum weight of 1.33 pounds per linear foot and shall have a minimum length of 5 feet.

5. Wire fence reinforcement for silt fences using standard-strength filter cloth shall be a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.

Installation

1. The height of a silt fence shall be a minimum of 16 inches above the original ground surface and shall not exceed 34 inches above ground elevation.

2. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.

3. A trench shall be excavated approximately 4-inches wide and 4-inches deep on the upslope side of the proposed location of the measure.

4. When wire support is used, standard-strength filter cloth may be used. Posts for this type of installation shall be placed a maximum of 10-feet apart (see Plate 3.05-1).

   The wire mesh fence must be fastened securely to the upslope side of the posts using heavy duty wire staples at least one inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two inches and shall not extend more than 34 inches above the original ground surface. The standard-strength fabric shall be stapled or wired to the wire fence, and 8 inches of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees.

5. When wire support is not used, extra-strength filter cloth shall be used. Posts for this type of fabric shall be placed a maximum of 6-feet apart (see Plate 3.05-2).

   The filter fabric shall be fastened securely to the upslope side of the posts using one inch long (minimum) heavy-duty wire staples or tie wires and eight inches of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees. This method of installation has been found to be more commonplace than #4.

6. If a silt fence is to be constructed across a ditch line or swale, the measure must be of sufficient length to eliminate endflow, and the plan configuration shall resemble an arc or horseshoe with the ends oriented upslope (see Plate 3.05-2). Extra-strength filter fabric shall be used for this application with a maximum 3-foot spacing of posts.

   All other installation requirements noted in #5 apply.

7. The 4-inch by 4-inch trench shall be backfilled and the soil compacted over the filter fabric.

8. Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

Maintenance

1. Silt fences shall be inspected immediately after rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.

2. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting.

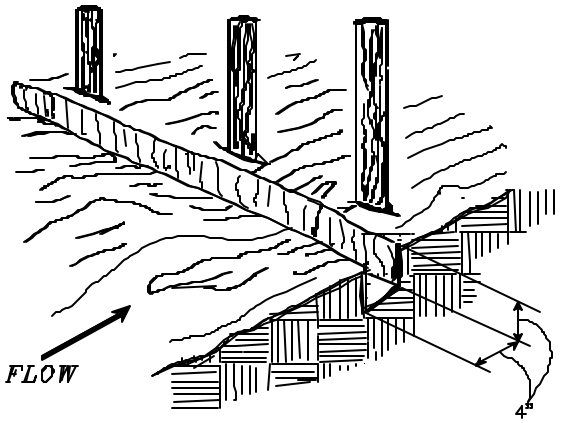
3. Should the fabric on a silt fence decompose or become ineffective prior to the end of the expected usable life and the barrier is still necessary, the fabric shall be replaced promptly.

4. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.

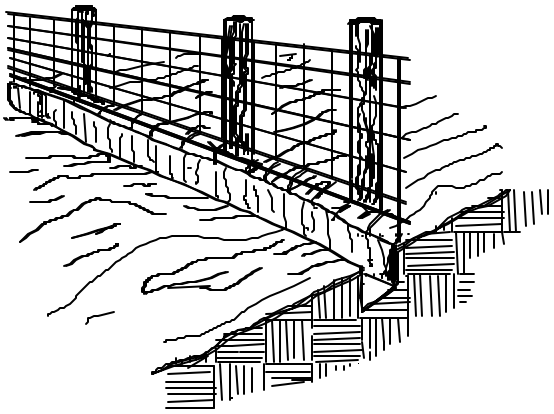
5. Any sediment deposits remaining in place after the silt fence is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

CONSTRUCTION OF A SILT FENCE (WITH WIRE SUPPORT)

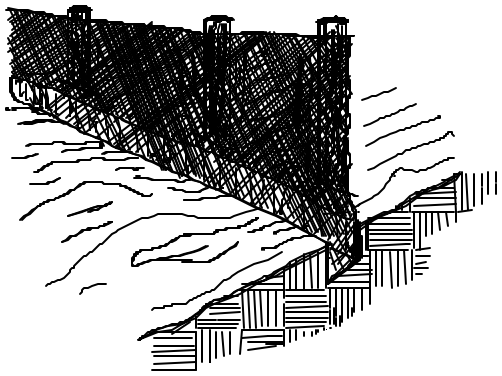
1. SET POSTS AND EXCAVATE A 4"X4" TRENCH UPSLOPE ALONG THE LINE OF POSTS.



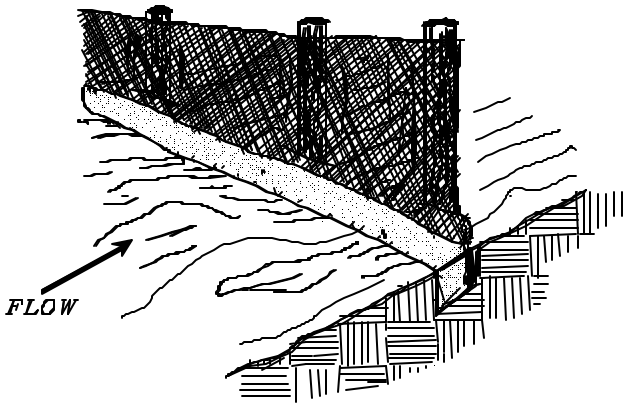
2. STAPLE WIRE FENCING TO THE POSTS.



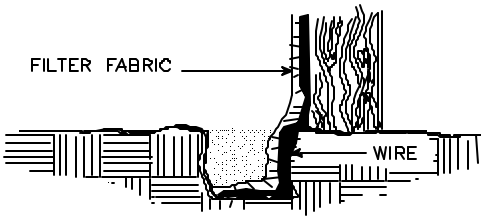
3 ATTACH THE FILTER FABRIC TO THE WIRE FENCE AND EXTEND IT INTO THE TRENCH.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.



EXTENSION OF FABRIC AND WIRE INTO THE TRENCH

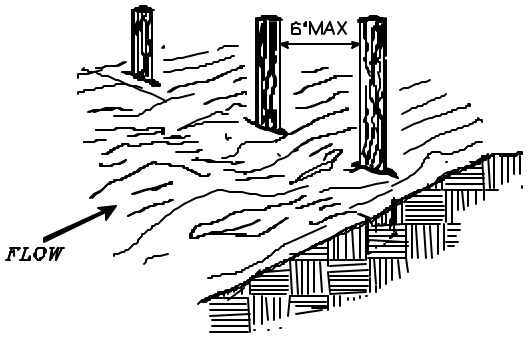


SOURCE: Adapted from Installation of Straw and Fabric Filter Barriers for Sediment Control, Sherwood & Wyant

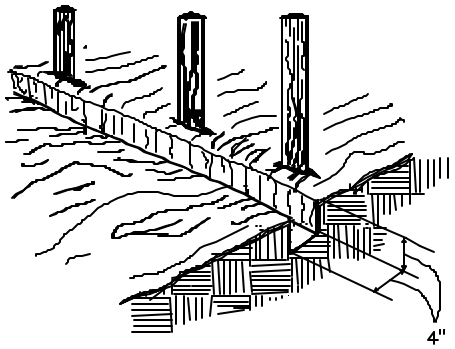
PLATE. 3.05-1

CONSTRUCTION OF A SILT FENCE (WITHOUT WIRE SUPPORT)

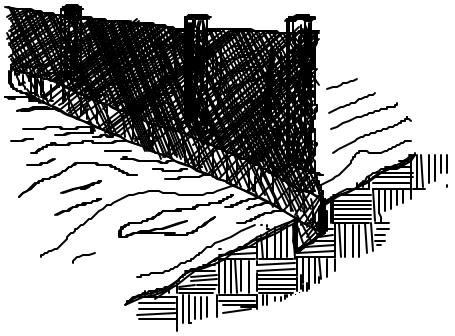
1. SET THE STAKES.



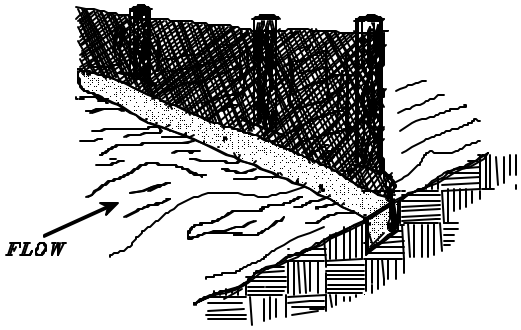
2. EXCAVATE A 4"X 4" TRENCH UPSLOPE ALONG THE LINE OF STAKES.



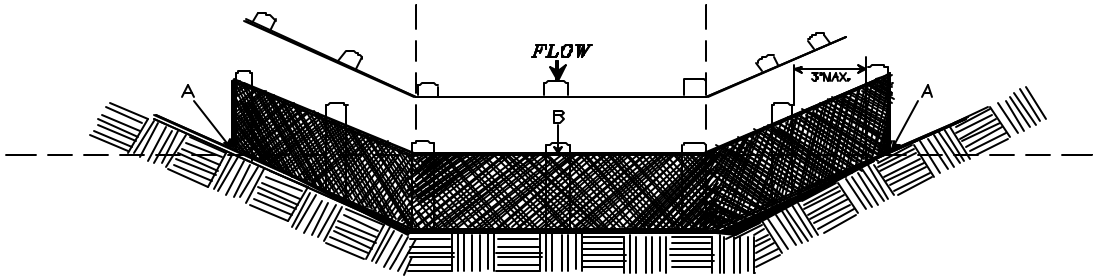
3. STAPLE FILTER MATERIAL TO STAKES AND EXTEND IT INTO THE TRENCH.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.



SHEET FLOW INSTALLATION
(PERSPECTIVE VIEW)



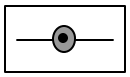
POINTS A SHOULD BE HIGHER THAN POINT B.

DRAINAGEWAY INSTALLATION
(FRONT ELEVATION)

SOURCE: Adapted from Installation of Straw and Fabric Filter Barriers for Sediment Control,VA. DSWC Sherwood and Wyant

PLATE. 3.05-2

STD & SPEC 3.07
STORM DRAIN INLET PROTECTION



IP

Practice Description

A sediment filter or an excavated impounding area around a storm drain drop inlet or curb inlet used to prevent sediment from entering storm drainage systems prior to permanent stabilization of the disturbed area.

Conditions Where Practice Applies

Where storm drain inlets are to be made operational before permanent stabilization of the corresponding disturbed drainage area. Different types of structures are applicable to different conditions (see Plates 3.07-1 through 3.07-8).

Construction Specifications

1. Silt Fence Drop Inlet Protection

   a. Silt Fence shall conform to the construction specifications for "extra strength" found in Table 3.05-B and shall be cut from a continuous roll to avoid joints.

   b. For stakes, use 2 x 4-inch wood (preferred) or equivalent metal with a minimum length of 3 feet.

   c. Space stakes evenly around the perimeter of the inlet a maximum of 3-feet apart, and securely drive them into the ground, approximately 18-inches deep (see Plate 3.07-1).

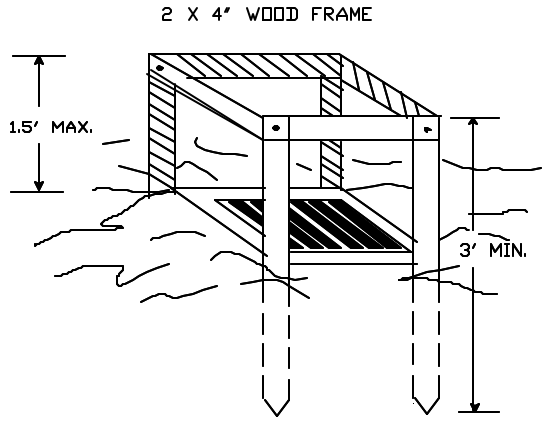
   d. To provide needed stability to the installation, frame with 2 x 4-inch wood strips around the crest of the overflow area at a maximum of 1½feet above the drop inlet crest.

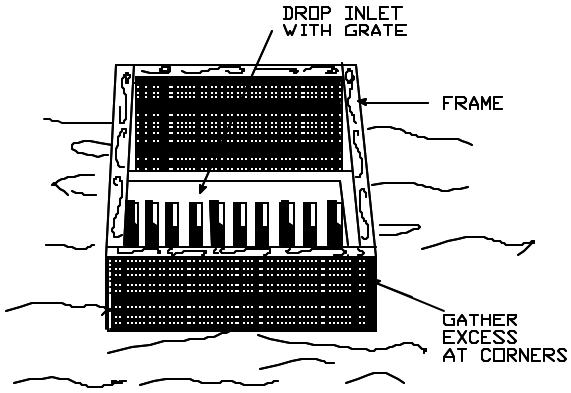
   e. Place the bottom 12 inches of the fabric in a trench Plate 3.07-1) and backfill the trench with 12 inches of compacted soil.

   f. Fasten fabric securely by staples or wire to the stakes and frame. Joints must be overlapped to the next stake.

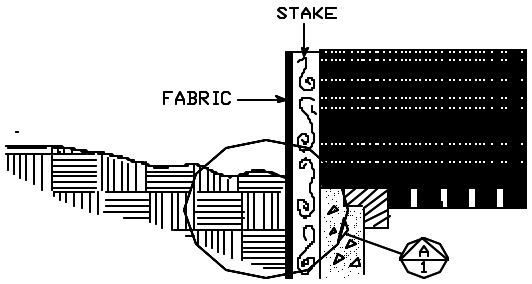
   g. It may be necessary to build a temporary dike on the downslope side of the structure to prevent bypass flow.

SILT FENCE DROP INLET PROTECTION

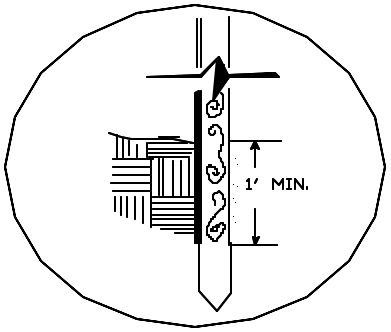




PERSPECTIVE VIEWS



ELEVATION OF STAKE AND FABRIC ORIENTATION



DETAIL A

SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE WHERE THE INLET DRAINS A RELATIVELY FLAT AREA (SLOPE NO GREATER THAN 5%) WHERE THE INLET SHEET OR OVERLAND FLOWS (NOT EXCEEDING 1 C.F.S.) ARE TYPICAL. THE METHOD SHALL NOT APPLY TO INLETS RECEIVING CONCENTRATED FLOWS, SUCH AS IN STREET OR HIGHWAY MEDIANS.

SOURCE: N.C. Erosion and Sediment Control Planning and Design Manual, 1988

PLATE 3.07-1

2. Gravel and Wire Mesh Drop Inlet Sediment Filter

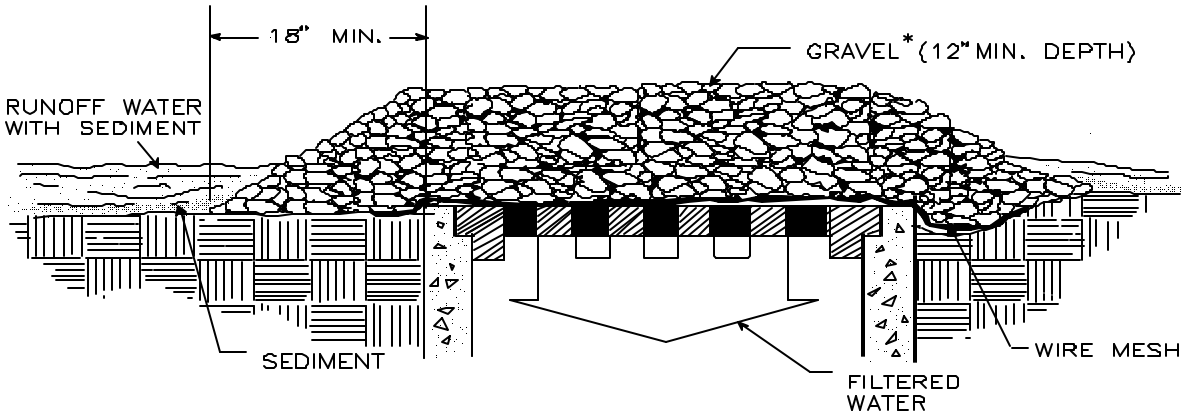
a. Wire mesh shall be laid over the drop inlet so that the wire extends a minimum of 1 foot beyond each side of the inlet structure. Wire mesh with 1/2-inch openings shall be used. If more than one strip of mesh is necessary, the strips shall be overlapped.

b. Coarse aggregate shall be placed over the wire mesh as indicated on Plate 3.07-2. The depth of stone shall be at least 12 inches over the entire inlet opening. The stone shall extend beyond the inlet opening at least 18 inches on all sides.

c. If the stone filter becomes clogged with sediment so that it no longer adequately performs its function, the stones must be pulled away from the inlet, cleaned and/or replaced.

Note: This filtering device has no overflow mechanism; therefore, ponding is likely especially if sediment is not removed regularly. This type of device must never be used where overflow may endanger an exposed fill slope. Consideration should also be given to the possible effects of ponding on traffic movement, nearby structures, working areas, adjacent property, etc.

GRAVEL AND WIRE MESH DROP INLET SEDIMENT FILTER



SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE WHERE HEAVY CONCENTRATED FLOWS ARE EXPECTED, BUT NOT WHERE PONDING AROUND THE STRUCTURE MIGHT CAUSE EXCESSIVE INCONVENIENCE OR DAMAGE TO ADJACENT STRUCTURES AND UNPROTECTED AREAS.

* GRAVEL SHALL BE VDOT #3, #357 OR #5 COARSE AGGREGATE.

SOURCE: VA. DSWC

PLATE. 3.07-2

3. Block and Gravel Drop Inlet Sediment Filter

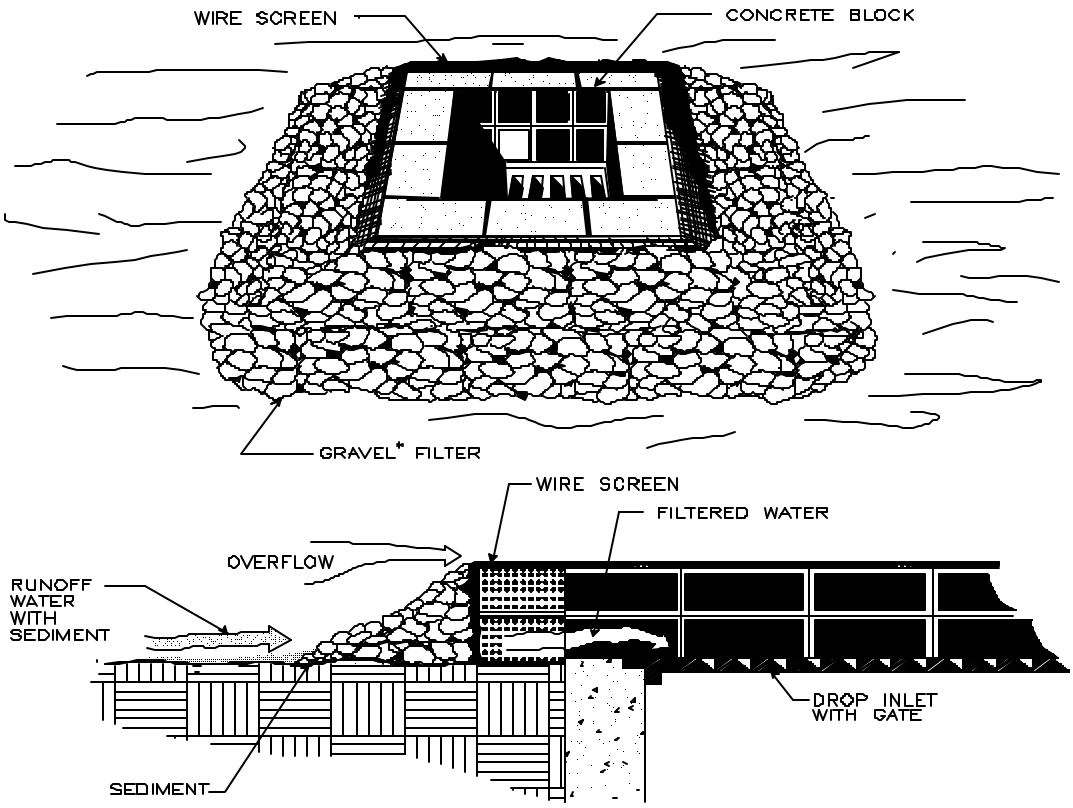
a. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, with the ends of the adjacent blocks abutting. The height of the barrier can be varied, depending on design needs, by stacking combinations of various width blocks. The barrier shall be no less than 12 inches high and no greater than 24 inches high.

b. Wire mesh shall be placed over the outside vertical face (webbing) of the blocks to prevent stone wash thru. Wire mesh with ½ openings shall be used.

c. Stone shall be place against the wire to the top of the barrier as shown in Plate 3.07-3.

d. The stone shall be removed cleaned and replaced when the sediment level reaches ½the barrier height.

BLOCK AND GRAVEL DROP INLET SEDIMENT FILTER



SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE WHERE HEAVY FLOWS ARE EXPECTED AND WHERE AN OVERFLOW CAPACITY IS NECESSARY TO PREVENT EXCESSIVE PONDING AROUND THE STRUCTURE.

* GRAVEL SHALL BE VDOT #3, #357 OR #5 COARSE AGGREGATE.

SOURCE: VA. DSWC

PLATE. 3.07-3

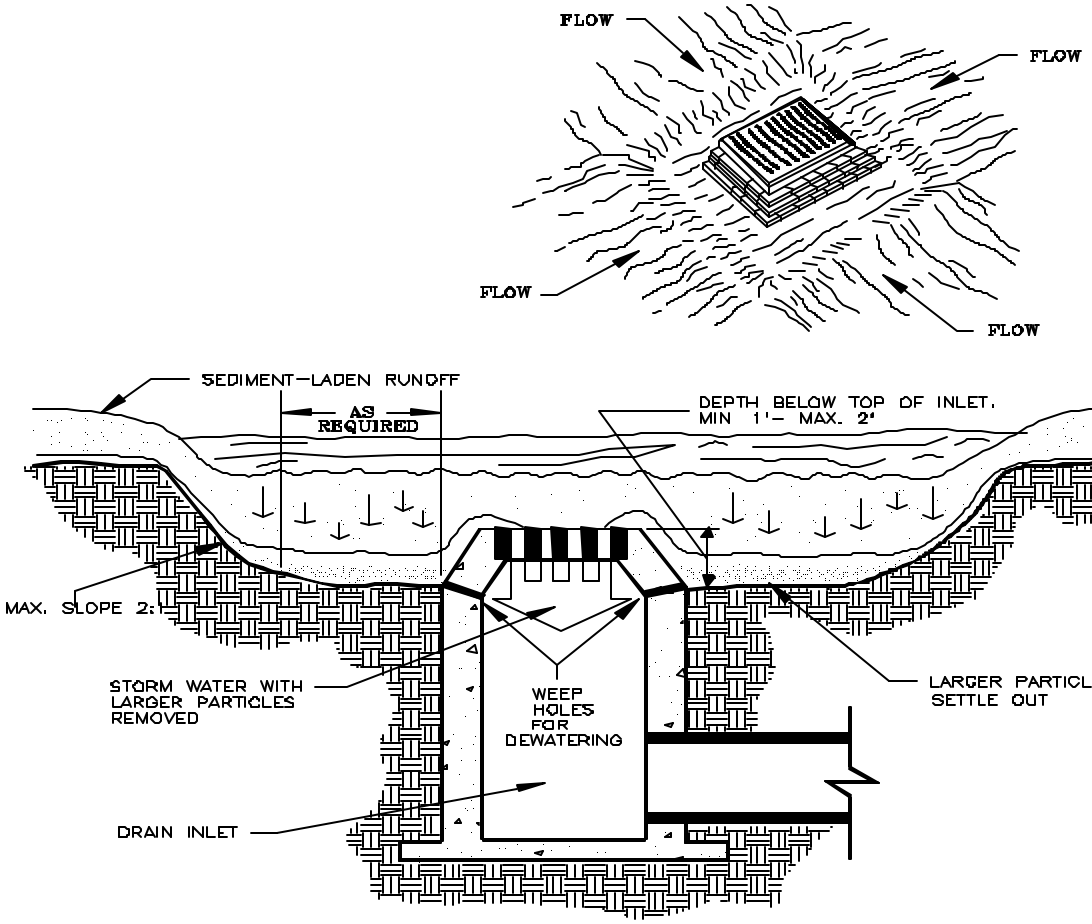
4. Excavated Drop Inlet Sediment Trap

a. The excavated trap shall be sized to provide a minimum storage capacity calculated at the rate of 134 cubic yards per acre of drainage area. A trap shall be no less than 1-foot nor more than 2-feet deep measured from the top of the inlet structure. Side slopes shall not be steeper than 2:1 (see Plate 3.07-4).

b. The slope of the basin may vary to fit the drainage area and terrain. Observations must be made to check trap efficiency and modifications shall be made as necessary to ensure satisfactory trapping of sediment. Where an inlet is located so as to receive concentrated flows, such as in a highway median, it is recommended that the basin have a rectangular shape in a 2:1 (length/width) ratio, with the length oriented in the direction of the flow.

c. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one-half the design depth of the trap. Removed sediment shall be deposited in a suitable area and in a manner such that it will not erode.

EXCAVATED DROP INLET SEDIMENT TRAP



SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE WHERE HEAVY FLOWS ARE EXPECTED AND WHERE AN OVERFLOW CAPABILITY AND EASE OF MAINTENANCE ARE DESIRABLE.

SOURCE: MICHIGAN SOIL EROSION AND SEDIMENT CONTROL GUIDEBOOK, 1975, AND USDA-SCS

PLATE 3.07-4

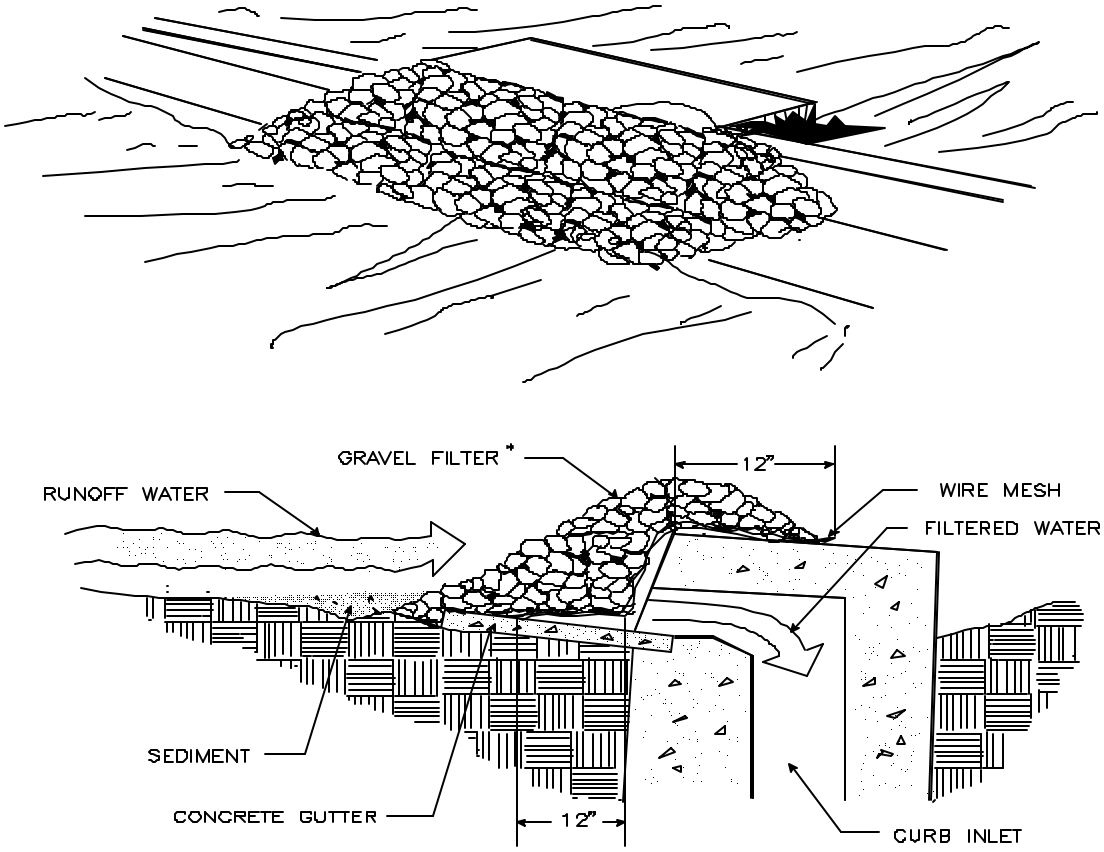
5. Gravel Curb Inlet Sediment Filter

   a. Wire mesh with 1/2-inch openings shall be placed over the curb inlet opening so that at least 12 inches of wire extends across the inlet cover and at least 12 inches of wire extends across the concrete gutter from the inlet opening, as depicted in Plate 3.07-6.

   b. Stone shall be piled against the wire so as to anchor it against the gutter and inlet cover and to cover the inlet opening completely.

   c. If the stone filter becomes clogged with sediment so that it no longer adequately performs its function, the stone must be pulled away from the block, cleaned and replaced.

GRAVEL CURB INLET SEDIMENT FILTER



SPECIFIC APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE AT CURB INLETS WHERE PONDING IN FRONT OF THE STRUCTURE IS NOT LIKELY TO CAUSE INCONVENIENCE OR DAMAGE TO ADJACENT STRUCTURES AND UNPROTECTED AREAS.

* GRAVEL SHALL BE VDOT #3, #357 OR 5 COARSE AGGREGATE.

SOURCE: VA. DSWC

PLATE 3.07–6

6. Block and Gravel Curb Inlet Sediment Filter

a. Two concrete blocks shall be placed on their sides abutting the curb at either side of the inlet opening.

b. A 2-inch x 4-inch stud shall be cut and placed through the outer holes of each spacer block to help keep the front blocks in place.

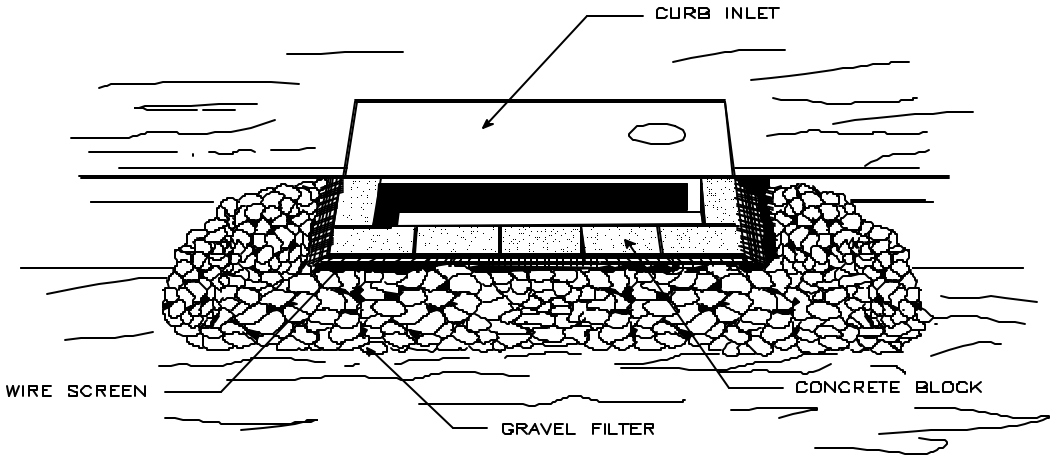
c. Concrete blocks shall be placed on their sides across the front of the inlet and abutting the spacer blocks as depicted in Plate 3.07-8.

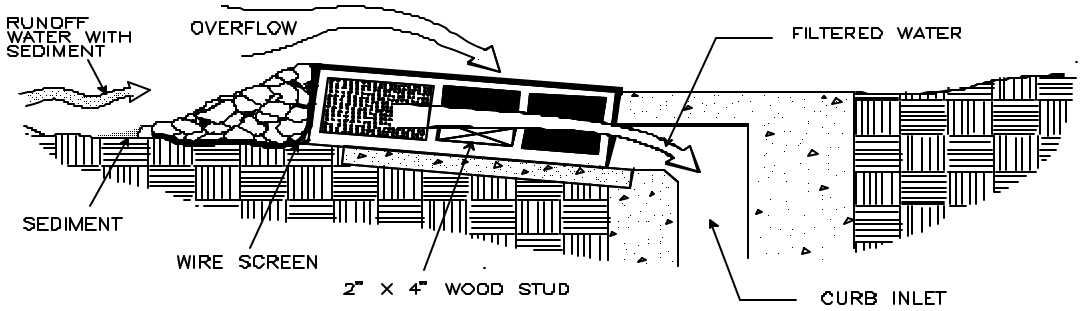
d. Wire mesh shall be placed over the outside vertical face (webbing) of the concrete blocks to prevent stone from being washed through the holes in the blocks. Wire mesh with 1/2-inch openings shall be used.

e. Coarse aggregate shall be piled against the wire to the top of the barrier as shown.

f. If the stone filter becomes clogged with sediment so that it no longer adequately performs its function, the stone must be pulled away from the blocks, cleaned and/or replaced.

BLOCK & GRAVEL CURB INLET SEDIMENT FILTER





SPECIAL APPLICATION

THIS METHOD OF INLET PROTECTION IS APPLICABLE AT CURB INLETS WHERE AN OVERFLOW CAPABILITY IS NECESSARY TO PREVENT EXCESSIVE PONDING IN FRONT OF THE STRUCTURE.

* GRAVEL SHALL BE VDOT #3, #357 OR #5 COARSE AGGREGATE

SOURCE: VA. DSWC PLATE 3.07-8

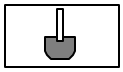
Maintenance

1. The structure shall be inspected after each rain and repairs made as needed.

2. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one half the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.

3. Structures shall be removed when the remaining drainage area has been properly stabilized.

STD & SPEC 3.08
CULVERT INLET PROTECTION



CIP

Practice Description

A sediment filter located at the inlet to storm sewer culverts, used to prevent sediment from entering, accumulating in and being transferred by a culvert and associated drainage system prior to permanent stabilization of a disturbed project area; and, to provide erosion control at culvert inlets during the phase of a project where elevation and drainage patterns change, causing original control measures to be ineffective or in need of removal.

Conditions Where Practice Applies

Where culvert and associated drainage system is to be made operational prior to permanent stabilization of the disturbed drainage area. Different types of structures are applicable to different conditions (see Plates 3.08-1 and 3.08-2).

General Guidelines (All Types)

1. The inlet protection device shall be constructed in a manner that will facilitate clean-out and disposal of trapped sediment and minimize interference with construction activities.

2. The inlet protection devices shall be constructed in such a manner that any resultant ponding of stormwater will not cause excessive inconvenience or damage to adjacent areas or structures.

3. Design criteria more specific to each particular inlet protection device will be found in Plates 3.08-1 through 3.08-2.

Construction Specifications

1. Silt Fence Culvert Inlet Protection

   a. The height of the silt fence (in front of the culvert opening) shall be a minimum of 16 inches and shall not exceed 34 inches.

   b. Extra strength filter fabric with a maximum spacing of stakes of 3 feet shall be used to construct the measure.

   c. The placement of silt fence should be approximately 6 feet from the culvert in the direction of incoming flow, creating a "horseshoe" shape as shown in Plate 3.08-1.

   d. If silt fence cannot be installed properly or the flow and/or velocity of flow to the culvert protection is excessive and may breach the structure, the stone combination noted in Plate 3.08-1 should be utilized.

2. Culvert Inlet Sediment Trap

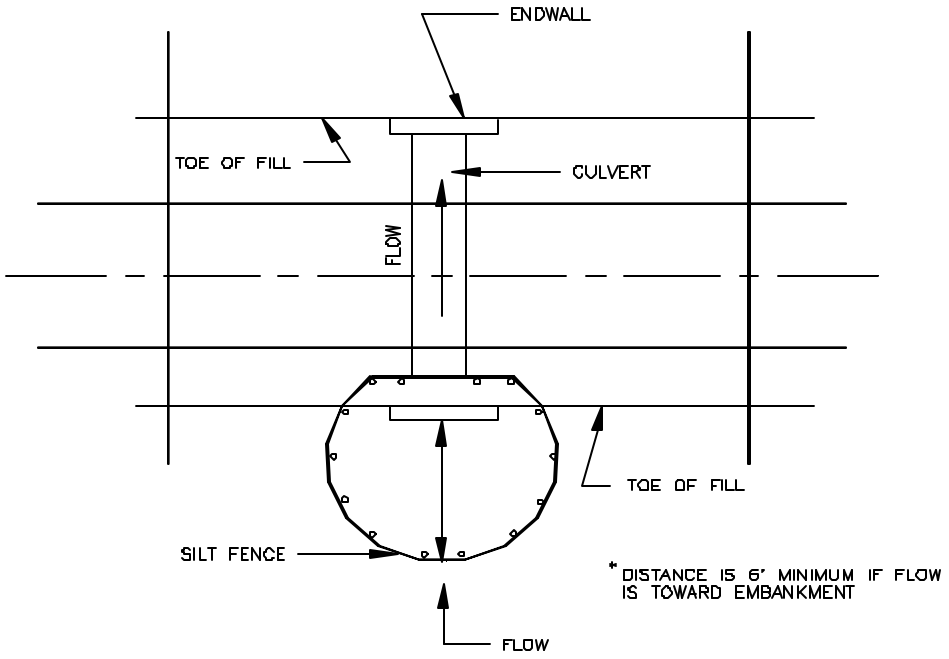
a. Geometry of the design will be a "horseshoe" shape around the culvert inlet (see Plate 3.08-2).

b. The toe of riprap (composing the sediment filter dam) shall be no closer than 24" from the culvert opening in order to provide an acceptable emergency outlet for flows from larger storm events.

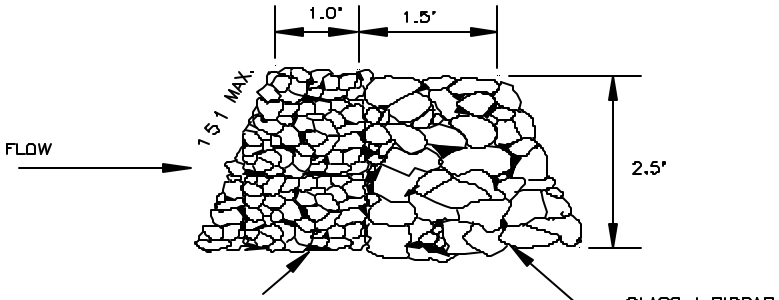
c. All other "Construction Specifications" found within Std. & Spec. 3.13, TEMPORARY SEDIMENT TRAP, also apply to this practice.

d. The proper installation of the culvert inlet sediment trap is a viable substitute for the installation of the TEMPORARY SEDIMENT TRAP.

SILT FENCE CULVERT INLET PROTECTION



*OPTIONAL STONE COMBINATION

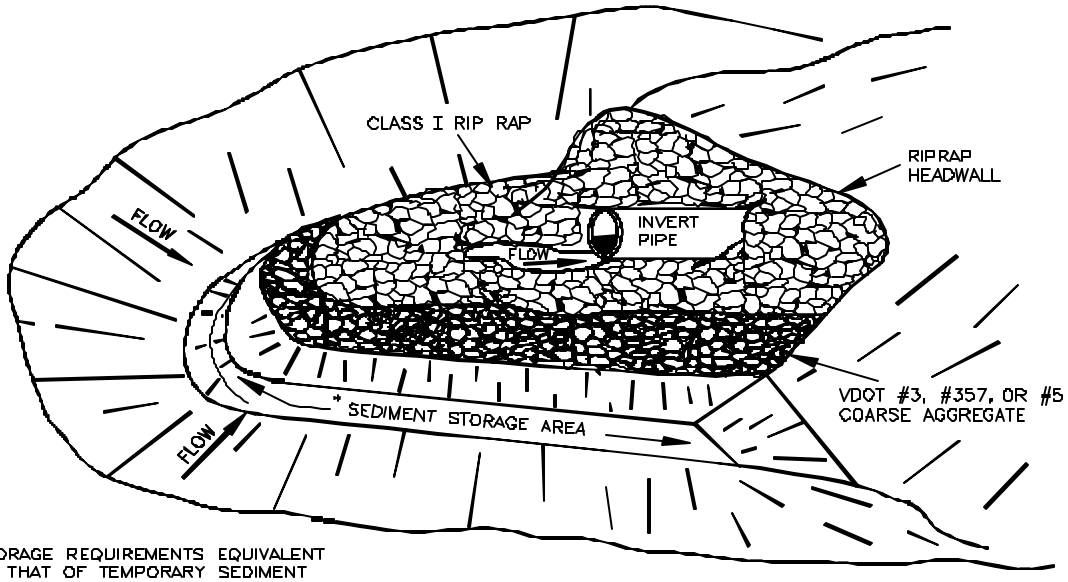


*VDOT #3, #357, #5, #56 OR #57 COARSE AGGREGATE TO REPLACE SILT FENCE IN " HORSESHOE " WHEN HIGH VELOCITY OF FLOW IS EXPECTED

SOURCE: ADAPTED from VDOT Standard Sheets and Va. DSWC

PLATE. 3.08-1

CULVERT INLET SEDIMENT TRAP

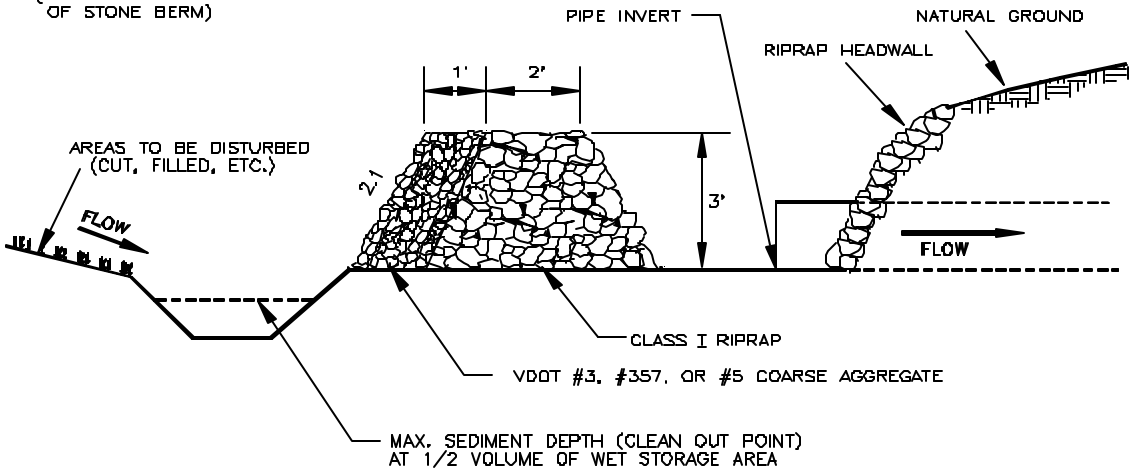


*STORAGE REQUIREMENTS EQUIVALENT TO THAT OF TEMPORARY SEDIMENT TRAP, STD. & SPEC. 3.13

67 C.Y./ACRE WET STORAGE (BELOW BASE OF STONE)

67 C.Y./ACRE DRY STORAGE (BASE OF STONE TO TOP OF STONE BERM)

PERSPECTIVE VIEW



ELEVATION

SOURCE: NORTH CAROLINA SEDIMENT CONTROL COMMISSION PLATE. 3.08-2

Maintenance

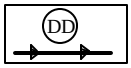
1. The structure shall be inspected after each rain and repairs made as needed.

2. Aggregate shall be replaced or cleaned when inspection reveals that clogged voids are causing ponding problems that interfere with on-site construction.

3. Sediment shall be removed and the impoundment restored to its original dimensions when sediment has accumulated to one-half the design depth. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode and cause sedimentation problems.

4. Temporary structures shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

STD & SPEC 3.09
TEMPORARY DIVERSION DIKE



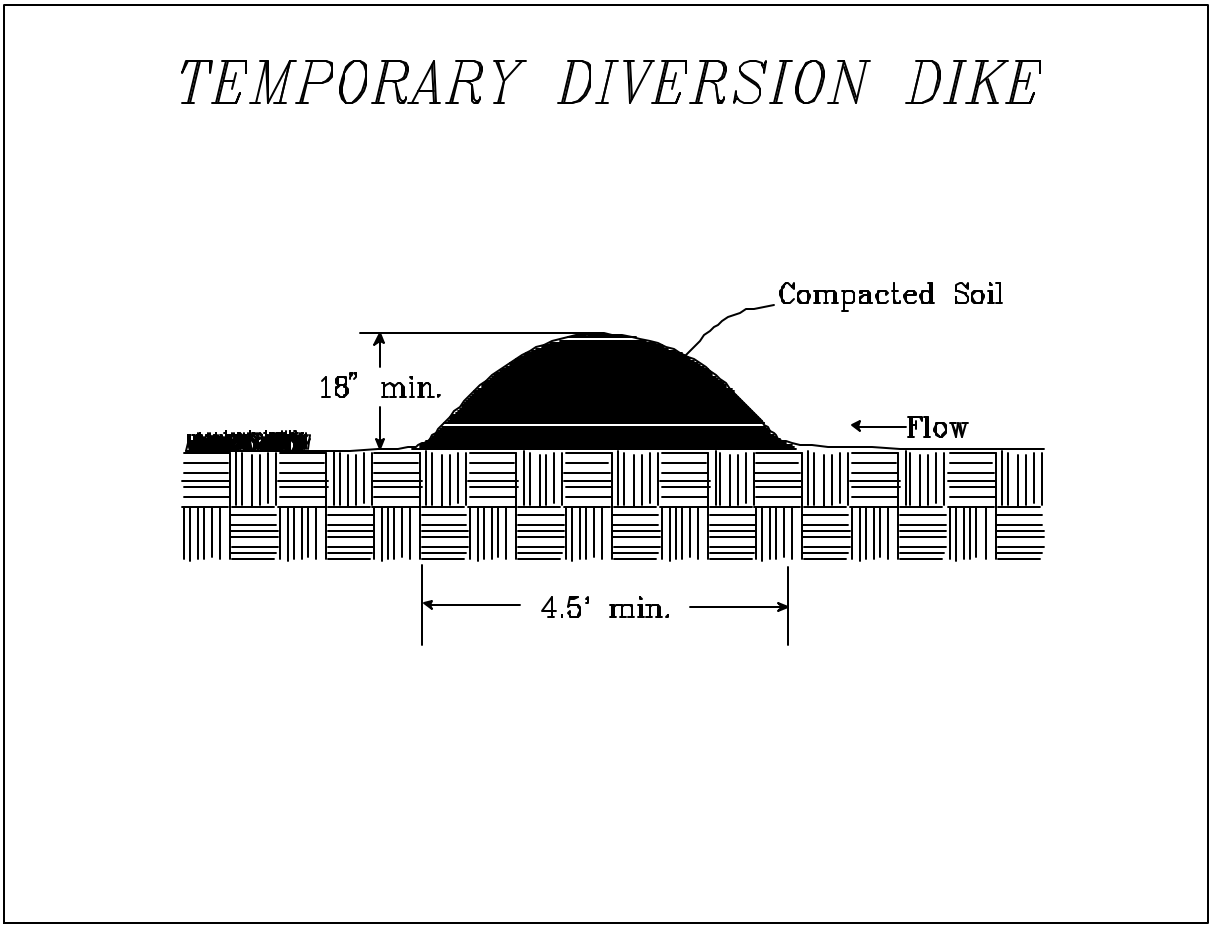
DD

Practice Description

A temporary ridge of compacted soil constructed at the top of a sloping disturbed area, to divert storm runoff from upslope drainage areas away from unprotected disturbed areas and slopes to a stabilized outlet and to divert sediment-laden runoff from a disturbed area to sediment-trapping facility such as a sediment trap or sediment basin.

Conditions Where Practice Applies

Whenever stormwater runoff must be temporarily diverted to protect disturbed areas and slopes or retain sediment on site during construction. These structures generally have a life expectancy of 18 months or less, which can be prolonged with proper maintenance.



SOURCE: VA. DSWC

PLATE 3.09-1

Construction Specifications

1. Height: The minimum allowable height measured from the upslope side of the dike is 18 inches.

2. Side Slopes: 1 1/2:1 or flatter, along with a minimum base width of 4.5 feet (see Plate 3.09-1).

3. Grade: The channel behind the dike shall have a positive grade to a stabilized outlet. If the channel slope is less than or equal to 2%, no stabilization is required. If the slope is greater 2%, the channel shall be stabilized in accordance with Std. & Spec. 3.17, STORMWATER CONVEYANCE CHANNEL.

4. Outlet: The diverted runoff, if free of sediment, must be released through a stabilized outlet or channel. Sediment-laden runoff must be diverted through a sediment trapping facility.

5. Temporary diversion dikes must be installed as a first step in the land-disturbing activity and must be functional prior to upslope land disturbance.

6. The dike should be adequately compacted to prevent failure.

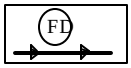
7. Temporary or permanent seeding and mulch shall be applied to the dike immediately following its construction.

8. The dike should be located to minimize damages by construction and traffic.

Maintenance

The measure shall be inspected after every storm and repairs made to the dike, flow channel, outlet or sediment trapping facility, as necessary. Once every two weeks, whether a storm event has occurred or not, the measure shall be inspected and repairs made if needed. Damages caused by construction traffic or other activity must be repaired before the end of each working day.

STD & SPEC 3.10
TEMPORARY FILL DIVERSION



FD

Practice Description

A channel with a supporting ridge of soil on the lower side, constructed along the top of an active earth fill, to divert storm runoff away from the unprotected slope of the fill to a stabilized outlet or sediment-trapping facility.

Conditions Where Practice Applies

Where the drainage area at the top of an active earth fill slopes toward the exposed slope and where continuous fill operations make the use of a DIVERSION (Std. & Spec. 3.12) unfeasible. This temporary structure should remain in place for less than one week. The maximum allowable drainage area is 5 acres.

Construction Specifications

1. Height: The minimum height of the supporting ridge shall be 9 inches (see Plate 3.10-1).

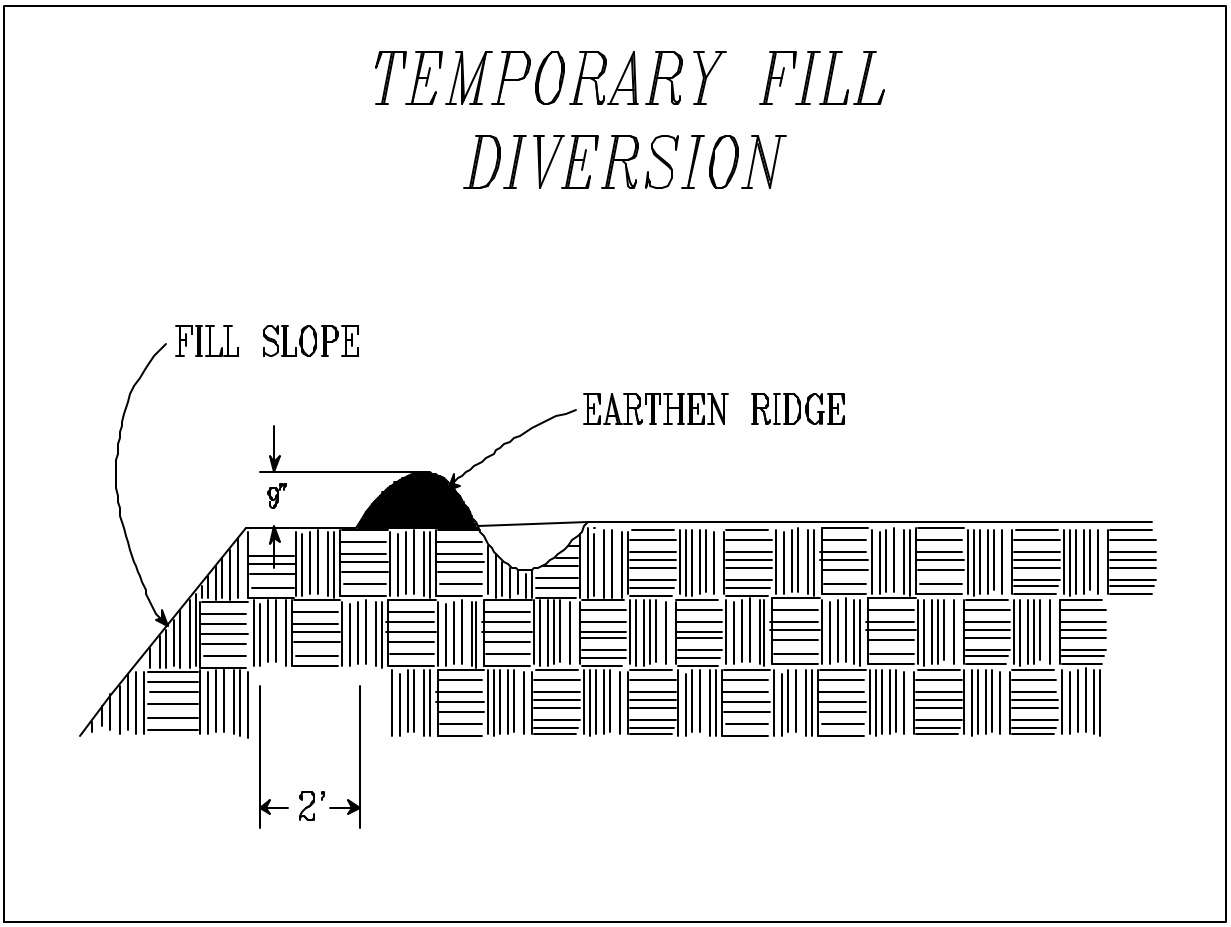
2. Grade: The channel shall have a positive grade to a stabilized outlet.

3. Outlet: The diverted runoff should be released through a stabilized outlet, slope drain or sediment trapping measure.

4. The diversion shall be constructed at the top of the fill at the end of each work day as needed.

5. The diversion shall be located at least 2 feet inside the top edge of the fill (see Plate 3.10-1).

6. The supporting ridge shall be constructed with a uniform height along its entire length. Without uniform height, the fill diversion may be susceptible to breaching.

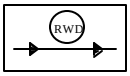


SOURCE: VA. DSWC PLATE 3.10-1

Maintenance

Since the practice is temporary and under most situations will be covered the next work day, the maintenance required should be low. If the practice is to remain in use for more than one day, an inspection will be made a the end of each work day and repairs made to the measure if needed. The contractor should avoid the placement of any material over the structure while it is in use. Construction traffic should not be permitted to cross the diversion.

STD & SPEC 3.11
TEMPORARY RIGHT-OF-WAY DIVERSION



RWD

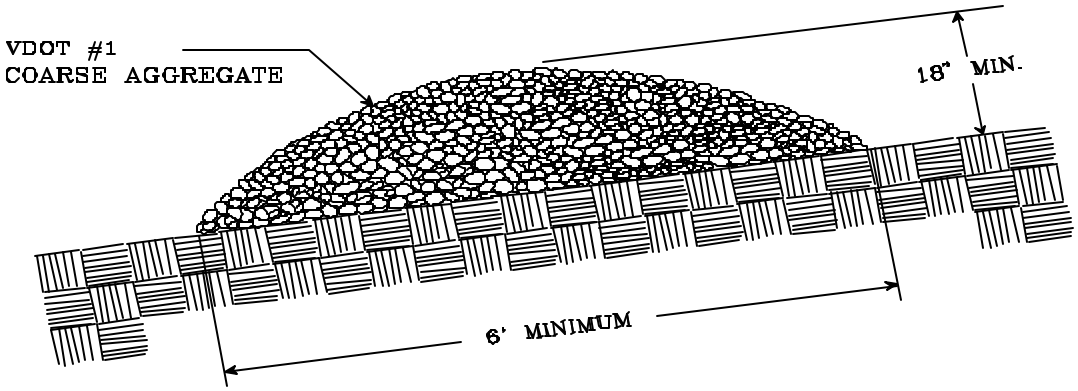
Practice Description

A ridge of compacted soil or loose rock or gravel constructed across disturbed rights-of-way and similar sloping areas, to shorten the flow length within a sloping right-of-way, thereby reducing the erosion potential by diverting storm runoff to a stabilized outlet.

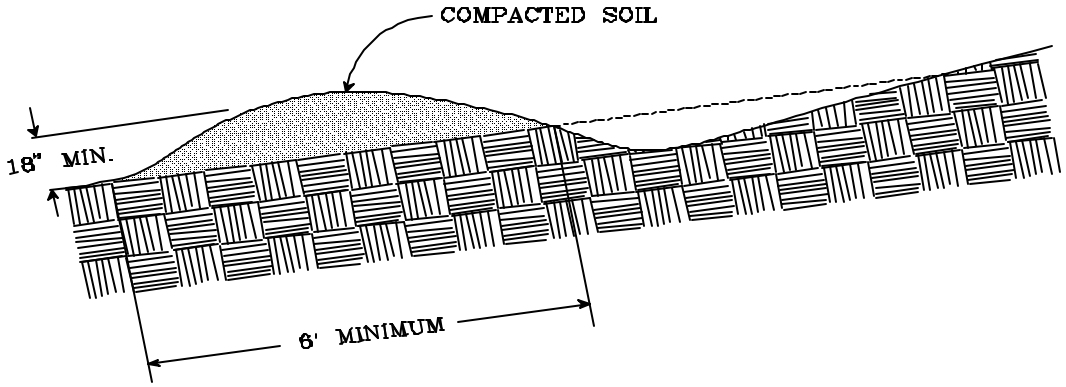
Conditions Where Practice Applies

Generally, earthen diversions are applicable where there will be little or no construction traffic within the right-of-way. Gravel structures are more applicable to roads and other rights-of-way that accommodate vehicular traffic.

TEMPORARY RIGHT-OF-WAY DIVERSIONS



TYPICAL GRAVEL STRUCTURE



TYPICAL EARTHEN STRUCTURE

Source: Va. SWCC

Plate 3.11-1

TABLE 3.11-A
SPACING OF RIGHT OF WAY
DIVERSIONS

%Slope	Spacing (ft.)
Less than 7%	100
Between 7% and 25%	75
Between 25% and 40%	50
Greater than 40%	25

Construction Specifications

1. Height: The minimum allowable height of the diversion shall be 18 inches (see Plate 3.11-1).

2. Side Slopes: Side slopes should be 2:1 or flatter to allow the passage of construction traffic, along with a minimum base width of 6 feet (see Plate 3.11-1).

3. Width: The measure should be constructed completely across the disturbed portion of the right-of-way.

4. Spacing: Table 3.11-A will be used to determine the spacing of right-of-way diversions.

5. Grade: Positive drainage (with less than 2% slope) should be provided to a stabilized outlet, sediment-trapping facility, or a vegetative buffer strip of adequate size.

6. The diversion shall be installed as soon as the right-of-way has been cleared and/or graded.

7. All earthen diversions shall be machine- or hand-compacted in 8-inch lifts.

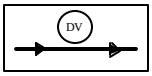
8. The outlet of the diversion shall be located on an undisturbed and stabilized area when at all possible. The field location should be adjusted as needed to utilize a stabilized outlet.

9. Earthen diversions which will not be subject to construction traffic should be stabilized in accordance with TEMPORARY SEEDING (Std. & Spec. 3.31).

Maintenance

The practice shall be inspected after every rainfall and repairs made if necessary. At least once every two weeks, whether a storm has occurred or not, the measure shall be inspected and repairs made if needed. Right-of-way diversions, which are subject to damage by vehicular traffic, should be reshaped at the end of each working day.

STD & SPEC 3.12
DIVERSION



DV

Practice Description

A channel constructed across a slope with a supporting earthen ridge on the lower side, to reduce slope length and to intercept and divert stormwater runoff to stabilized outlets at non-erosive velocities.

Conditions Where Practice Applies

1. Where runoff from areas of higher elevation may damage property, cause erosion, or interfere with the establishment of vegetation on lower areas.

2. Where surface and/or shallow subsurface flow is damaging sloping upland.

3. Where the slope length needs to be reduced to minimize soil loss.

Construction Specifications

1. Ridge: The supporting ridge cross-sectioned shall meet the following criteria:

   a. The side slopes shall be no steeper than 2:1.

   b. The width at the design water elevation shall be a minimum of 4 feet.

   c. The minimum freeboard shall be 0.3 foot.

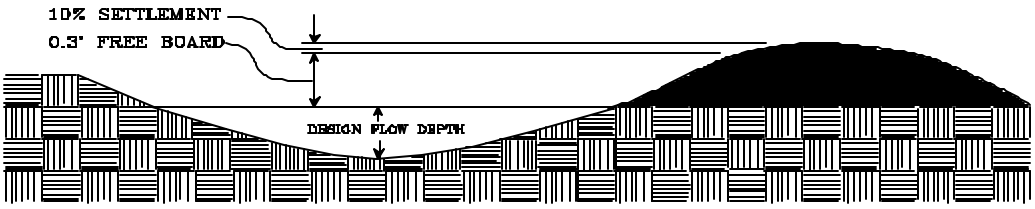
   d. The design shall include a 10 percent settlement factor.

2. Outlet: Diversions shall have adequate outlets which will convey concentrated runoff without erosion. Acceptable outlets include STORMWATER CONVEYANCE CHANNEL (Std. & Spec. 3.17); LEVEL SPREADER (Std. & Spec. 3.21); OUTLET PROTECTION (Std. & Spec. 3.18); and PAVED FLUME (Std. & Spec. 3.16).

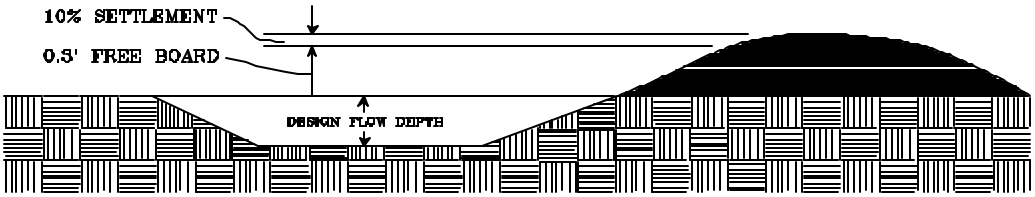
3. Stabilization:

   a. The ridge and channel shall be seeded and mulched immediately following their construction in accordance with Std. & Spec. 3.32, PERMANENT SEEDING.

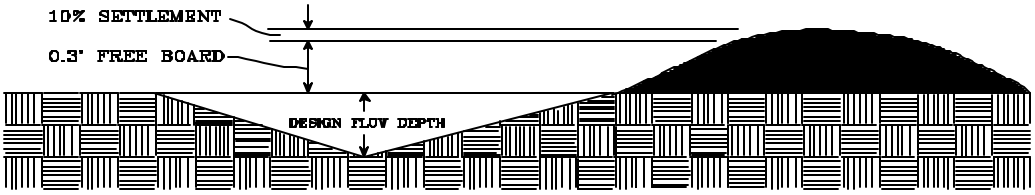
DIVERSIONS



TYPICAL PARABOLIC DIVERSION



TYPICAL TRAPEZOIDAL DIVERSION



TYPICAL VEE–SHAPED DIVERSION

Source: Va. DSWC

Plate 3.12–1

b. Disturbed areas draining into the diversion should normally be seeded and mulched prior to the time the diversion is constructed. Sediment trapping measures must remain in place to prevent soil movement into the diversion if upslope area is not stabilized.

4. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the diversion.

5. The diversion shall be excavated or shaped to line, grade, and cross-section as required to meet the criteria specified herein, free of irregularities that will impede flow.

6. Fills shall be compacted as needed to prevent unequal settlement that would cause damage in the completed diversion. Fill shall be composed of soil that is free from excessive organic debris, rocks or other objectionable materials.

7. All earth removed and not needed in construction shall be spread or disposed of so that it will not interfere with the functioning of the diversion.

8. Permanent stabilization of disturbed areas shall be done in accordance with the applicable standard and specification contained in this handbook. Permanent stabilization techniques include PERMANENT SEEDING (Std. & Spec. 3.32).

Maintenance

Before final stabilization, the diversion should be inspected after every rainfall and at least once every two weeks. Sediment shall be removed from the channel and repairs made as necessary. Seeded areas that fail to establish a vegetative cover shall be reseeded as necessary.

STD & SPEC 3.13
TEMPORARY SEDIMENT TRAP

ST

Practice Description

A temporary ponding area formed by constructing an earthen embankment with a stone outlet, used to detain sediment-laden runoff from small disturbed areas long enough to allow the majority of the sediment to settle out.

Conditions Where Practice Applies

1. Below disturbed areas where the total contributing drainage is less than 3 acres.

2. Where the sediment trap will be used no longer than 18 months (the maximum useful life is 18 months).

3. The sediment trap may be constructed either independently or in conjunction with a TEMPORARY DIVERSION DIKE (Std. & Spec. 3.09).

Construction Specifications

1. Outlet: The outlet for the sediment trap shall consist of a stone section of the embankment located at the low point in the basin. A combination of course aggregate and riprap shall be used to provide for filtering/detention as well as outlet stability. The smaller stone shall be VDOT #3, #357, or #5 Coarse Aggregate (smaller stone sizes will enhance filter efficiency) and riprap shall be "Class I". Filter cloth which meets the physical requirements noted in Std. & Spec. 3.19, RIPRAP shall be placed at the stone-soil interface to act as a "separator."

   The minimum length of the outlet shall be 6 feet times the number of acres comprising the total area draining to the trap. The crest of the stone outlet must be at least 1.0 foot below the top of the embankment to ensure that the flow will travel over the stone and not the embankment. The outlet shall be configured as noted in Plate 3.13-2.

2. Embankment Cross Section: The maximum height of the sediment trap embankment shall be 5 feet as measured from the base of the stone outlet. Minimum top widths (W) and outlet heights (Ho) for various embankment heights (H) are shown in Plate 3.13-1. Side slopes of the embankment shall be 2:1 of flatter.

3. The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat.

4. Fill material for the embankment shall be free of roots or other woody vegetation, organic material, large stones, and other objectionable material. The embankment should be compacted in 6-inch layers by traversing with construction equipment.

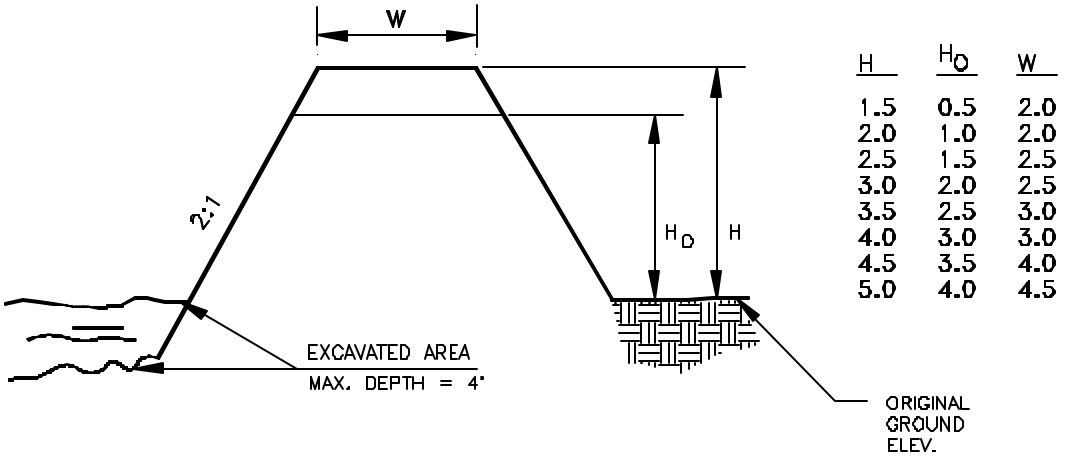
5. The earthen embankment shall be seeded with temporary or permanent vegetation (see Std. & Spec.'s 3.31 and 3.32) immediately after installation.

6. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.

7. The structure shall be removed and the area stabilized when the upslope drainage area has been stabilized.

8. All cut and fill slopes shall be 2:1 or flatter (except for excavated, wet storage area which may be at a maximum 1:1 grade).

MINIMUM TOP WIDTH (W) REQUIRED FOR SEDIMENT TRAP EMBANKMENTS ACCORDING TO HEIGHT OF EMBANKMENT (FEET)



H	H_D	W
1.5	0.5	2.0
2.0	1.0	2.0
2.5	1.5	2.5
3.0	2.0	2.5
3.5	2.5	3.0
4.0	3.0	3.0
4.5	3.5	4.0
5.0	4.0	4.5

SOURCE: VA. DSWC

PLATE. 3.13–1

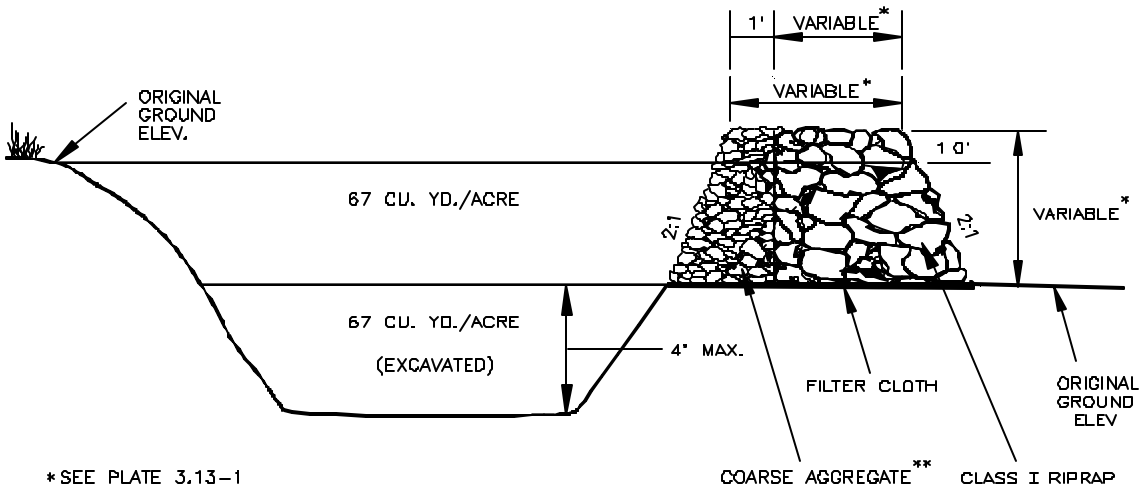
Maintenance

1. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one-half the design volume of the wet storage. Sediment removal from the basin shall be deposited in a suitable area and in such a manner that it will not erode and cause sedimentation problems.

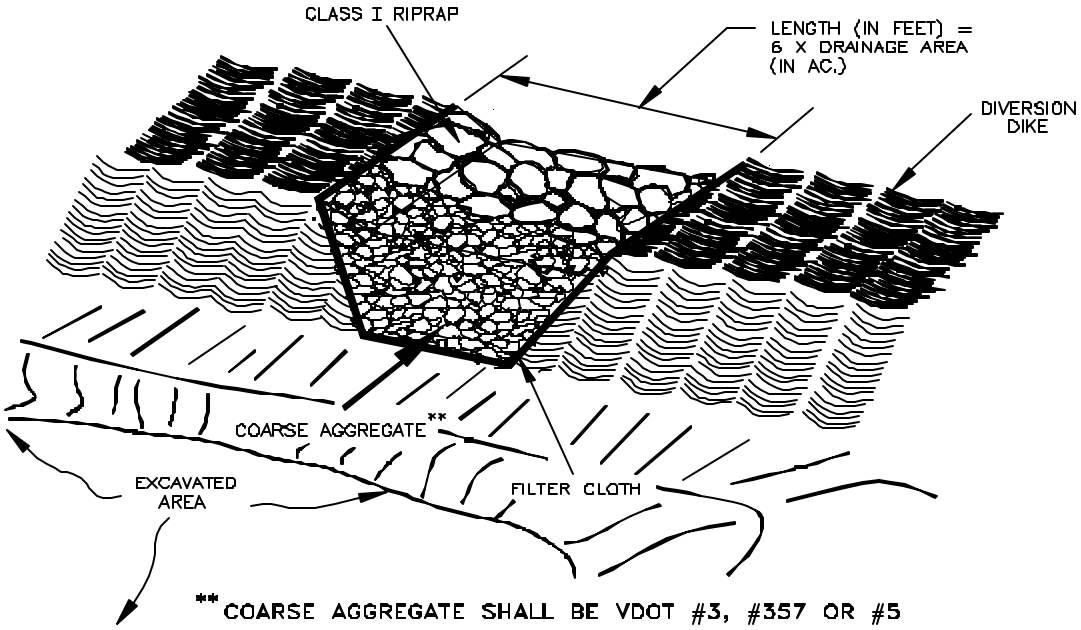
2. Filter stone shall be regularly checked to ensure that filtration performance is maintained. Stone choked with sediment shall be removed and cleaned or replaced.

3. The structure should be checked regularly to ensure that it is structurally sound and has not been damaged by erosion or construction equipment. The height of the stone outlet should be checked to ensure that its center is at least 1 foot below the top of the embankment.

TEMPORARY SEDIMENT TRAP



CROSS SECTION OF OUTLET



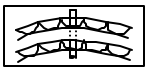
**COARSE AGGREGATE SHALL BE VDOT #3, #357 OR #5

OUTLET (PERSPECTIVE VIEW)

SOURCE: VA. DSWC

PLATE. 3.13-2

STD & SPEC 3.14
TEMPORARY SEDIMENT BASIN



SB

Practice Description

A temporary barrier or dam with a controlled stormwater release structure formed by constructing an embankment of compacted soil across a drainageway, used to detain sediment-laden runoff from disturbed areas in "wet" and "dry" storage long enough for the majority of the sediment to settle out.

Conditions Where Practice Applies

Constructed below disturbed areas where the total drainage area is equal to or greater than three (3) acres. There must be sufficient space and appropriate topography for the construction of a temporary impoundment. These structures are limited to a useful life of 18 months unless they are designed as permanent impoundments. It is recommended that these measures, by virtue of their potential to impound large volumes of water, be designed by a qualified professional.

Construction Specifications

1. Site Preparation: Areas under the embankment or any structural works related to the basin shall be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, and other objectionable material. In order to facilitate cleanout and restoration, the area of most frequent inundation (measured from the top of the principal spillway) will be cleared of all brush and trees.

2. Cutoff Trench: For earth-fill embankments, a cutoff trench shall be excavated along the centerline of the dam. The trench must extend at least 1 foot into a stable, impervious layer of soil and have a minimum depth of 2 feet. The cutoff trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be 4 feet, but also must be wide enough to permit operation of compaction equipment. The side slopes shall be no steeper than 1:1.

   Compaction requirements shall be the same as those for the embankment. The trench shall be drained during the backfilling/compacting operations.

3. Embankment: For embankments of less than 10 feet, the embankment must have a minimum top width of 6 feet, and the side slopes must be 2:1 or flatter. In the case of an embankment 10 to 14 feet in height, the minimum top width shall be 8 feet and the side slopes shall be 2-1/2:1 or flatter. For 15-foot embankment (maximum allowed under these specifications), the top width must be 10 feet with maximum 2-1/2:1 side slopes.

   The fill material shall be taken from approved borrow areas. It shall be clean mineral soil, free of roots, woody vegetation, stumps, sod, oversized stones, rocks, or other perishable or objectionable material. The material selected must have enough strength for the dam to remain stable and be tight enough, when properly compacted, to prevent excessive percolation of water through the dam. Fill containing particles ranging from small gravel or coarse sand to fine sand and clay in desired proportion is appropriate. Any embankment material should contain approximately 20% clay particles by weight.

Using the Unified Soil Classification System, SC (clayey sand), GC (clayey gravel) and CL ("low liquid limit" clay) are among the preferred types of embankment soils.

Areas on which fill is to be placed shall be scarified prior to placement of fill. The fill material should contain the proper amount of moisture to ensure that 95% compaction will be achieved. Fill material will be placed in 6-inch continuous layers over the entire length of fill. Compaction shall be obtained by routing the hauling equipment over the fill so that the entire surface of the fill is transversed by at least one wheel or tread track of equipment, or by using a compactor. Special care shall be taken in compacting around the anti-seep collars (compact by hand, if necessary) to avoid damage and achieve the desired compaction. The embankment shall be constructed to an elevation 10% higher than the design height to allow for settlement if compaction is obtained with hauling equipment. If compactors are used for compaction, the overbuild may be reduced to not less than 5%.

4. Principal Spillway: To increase the efficiency of the basin, the spillway(s) must be designed to maintain a permanent pool of water between storm events. The principal spillway should consist of a solid (non-perforated) vertical box or pipe of reinforced concrete or corrugated metal, with a minimum diameter of 15 inches. The riser of the spillway shall be securely attached to the barrel by a watertight connection. The barrel and riser shall be placed on a firmly compacted soil foundation. The base of the riser shall be firmly anchored according to design criteria to prevent its floating. Pervious materials such as sand, gravel, or crushed stone shall not be used as backfill around the barrel or anti-seep collars. Special care shall be taken in compacting around the anti-seep collars (by hand, if necessary). Fill material shall be placed around the pipe in 4-inch layers and compacted until 95% compaction is achieved. A minimum of two feet of fill shall be hand-compacted over the barrel before crossing it with construction equipment.

5. Base: The base of the principal spillway must be firmly anchored to prevent its floating. If the riser of the spillway is greater than 10 feet in height, computations must be made to determine the anchoring requirements. A minimum factor of safety of 1.25 shall be used (downward forces = 1.25 x upward forces).

   For risers 10 feet or less in height, the anchoring may be done in one of the two following ways:

   a. A concrete base 18 inches thick and twice the width of riser diameter shall be used and the riser embedded 6 inches into the concrete. (see Plate 3.14-14).

   b. A square steel plate a minimum of 1/4-inch thick and having a width equal to twice the diameter of the riser shall be used; it shall be covered with 2.5 feet of stone, gravel or compacted soil to prevent flotation (see Plate 3.14-14).

   Note: If the steel base is used, special attention should be given to compaction so that 95% compaction is achieved over the plate. Also, added precautions should be taken to ensure that material over the plate is not removed accidentally during removal of sediment from basin.

6. Anti-Vortex Device and Trash Rack: An anti-vortex device and trash rack shall be attached to the top of the principal spillway to improve the flow characteristics of water into spillway and prevent floating debris from blocking the principal spillway.

7. Dewatering: Dewatering of the dry storage should be done in a manner which removes the "cleaner" water without removing the potentially sediment-laden water found in the wet storage area or any appreciable quantities of floating debris.

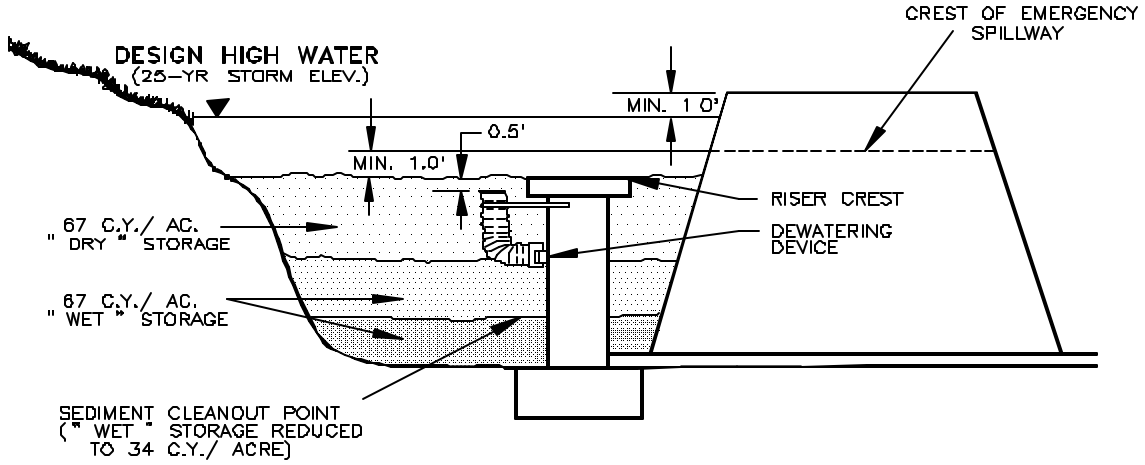
   An economical and efficient device for performing the drawdown is a section of perforated vertical tubing that is connected to the principal spillway at two locations. See Plate 3.14-15 that depicts the orientation of such a device. By virtue of the potential for the dewatering device or orifice becoming clogged, no credit is given for drawdown by the device in the calculation of the principal or emergency spillway locations.

8. Anti-Seep Collars: Anti-seep collars shall be used on the barrel of the principal spillway within the normal saturation zone of the embankment to increase the seepage length by at least 10%, if either of the following two conditions is met:

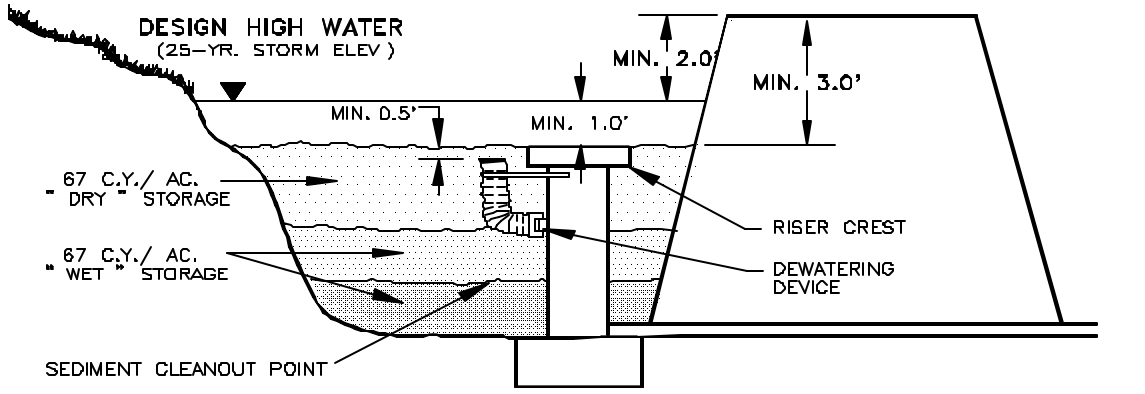
   a. The settled height of the embankment exceeds 10 feet.

   b. The embankment has a low silt-clay content (Unified Soil Classes SM or GM) and the barrel is greater than 10 inches in diameter.

SEDIMENT BASIN SCHEMATIC ELEVATIONS



DESIGN ELEVATIONS WITH EMERGENCY SPILLWAY



DESIGN ELEVATIONS WITHOUT EMERGENCY SPILLWAY

(RISER PASSES 25-YR. EVENT)

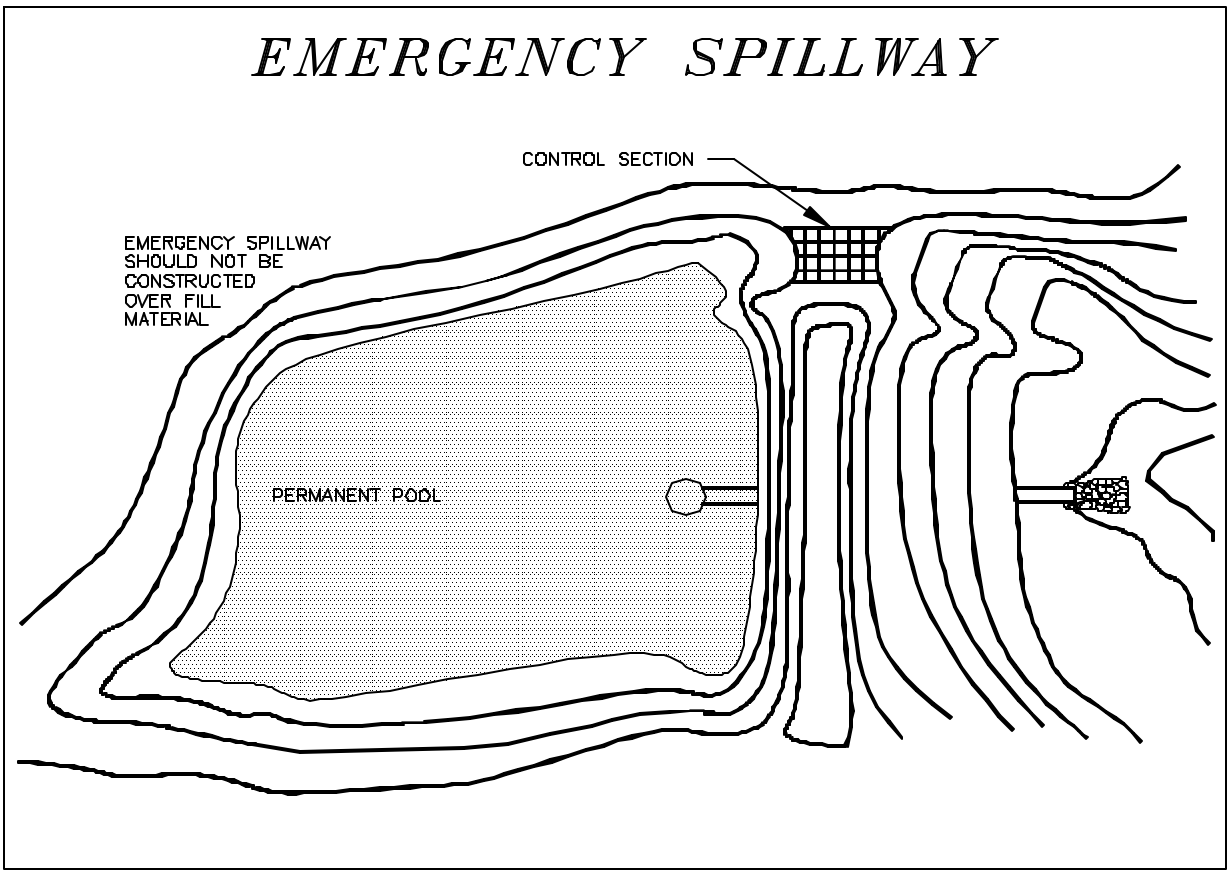
SOURCE: VA. DSWC

PLATE. 3.14-2

9. Emergency Spillway: Vegetative emergency spillways shall not be constructed over fill material. Design elevations, widths, entrance and exit slopes are critical to the successful operation of the spillway and should be adhered to closely during construction.

10. Vegetative Stabilization: The embankment and emergency spillway of the sediment basin shall be stabilized with temporary or permanent vegetation immediately after installation of the basin (see TEMPORARY SEEDING, Std. & Spec. 3.31 or PERMANENT SEEDING, Std. & Spec. 3.32).

11. Basin Shape: The shape of the basin must be such that the length to width ratio is at least 2 to 1. The correct basin shape can be obtained by proper site selection, excavation, or the use of baffles. Baffles increase the flow length by deflecting the flow. The baffles should be placed halfway between the inflow point and the outflow. Plate 3.14-6 shows the detail for baffle construction and three situations where baffles might be used.



SOURCE: VA. DSWC

PLATE. 3.14-5

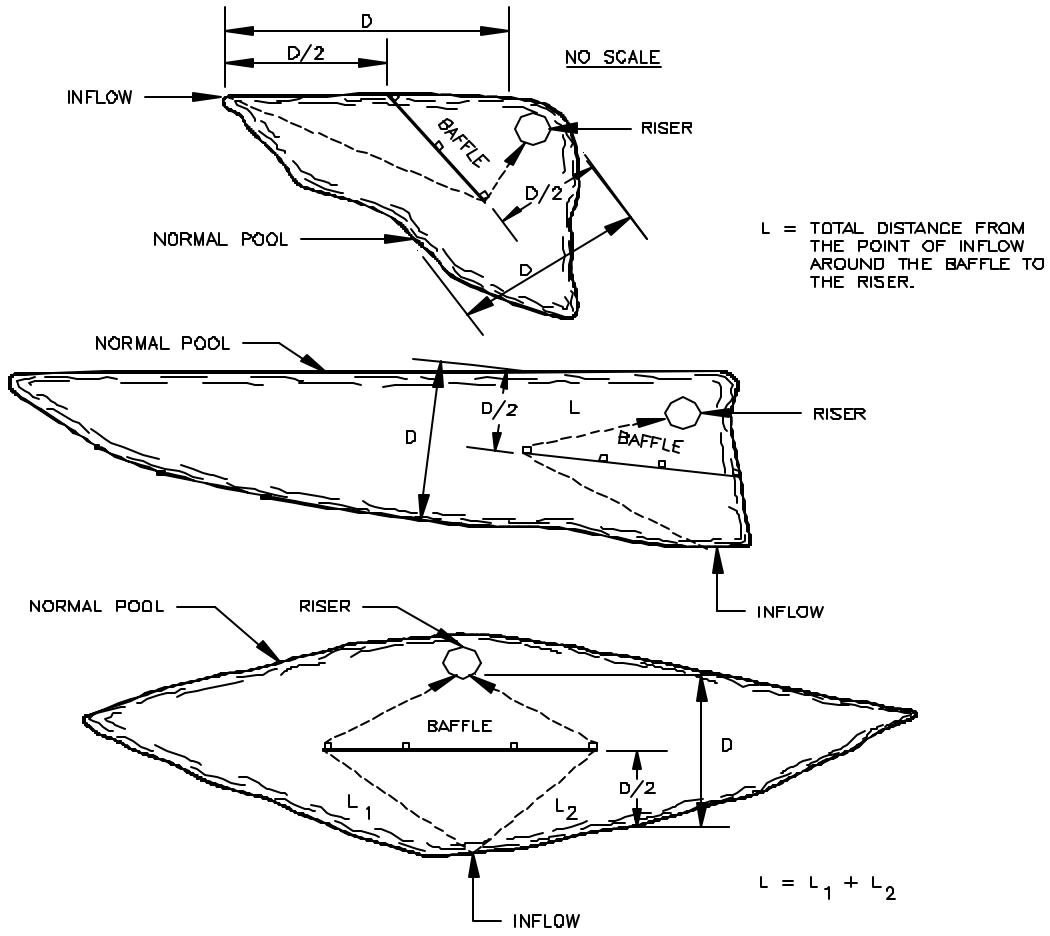
12. Safety: All state and local requirements shall be met concerning fencing and signs warning the public of the hazards of soft, saturated sediment and flood waters should be installed.

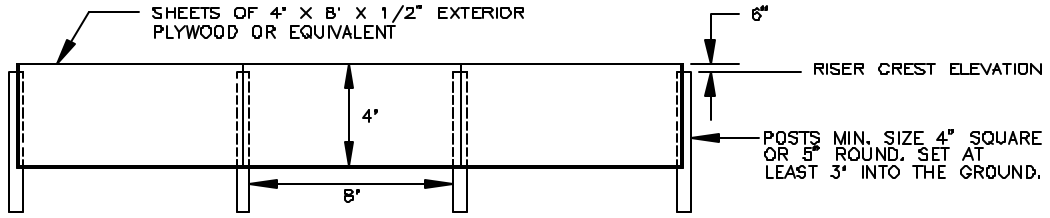
13. Erosion and Sediment Control: The construction of the sediment basin shall be carried out in a manner such that it does not result in sediment problems downstream.

Maintenance

The basin embankment should be checked regularly to ensure that it is structurally sound and has not been damaged by erosion or construction equipment. The emergency spillway should be checked regularly to ensure that its lining is well established and erosion resistant. The basin should be checked after each runoff-producing rainfall for sediment build-up. When sediment reaches the cleanout level, it shall be removed and disposed of properly.

EXAMPLE PLAN VIEWS OF BAFFLE LOCATIONS IN SEDIMENT BASINS





SOURCE: USDA–SCS

PLATE. 3.14–6

STD & SPEC 3.15
TEMPORARY SLOPE DRAIN

TSD

Practice Description

A flexible tubing or conduit extending from the top to the bottom of a cut or fill slope, to temporarily conduct concentrated stormwater runoff safely down the face of a cut or fill slope without causing erosion on or below the slope.

Conditions Where Practice Applies

On cut or fill slopes where there is a potential for upslope flows to move over the face of the slope causing erosion and preventing adequate stabilization.

Construction Specifications

1. The measure shall be placed on undisturbed soil or well-compacted fill.

2. The entrance section shall slope toward the slope drain at the minimum rate of 1/2-inch per foot.

3. The soil around and under the entrance section shall be hand-tamped in 8-inch lifts to the top of the dike to prevent piping failure around the inlet.

4. The slope drain shall be securely staked to the slope at the grommets provided.

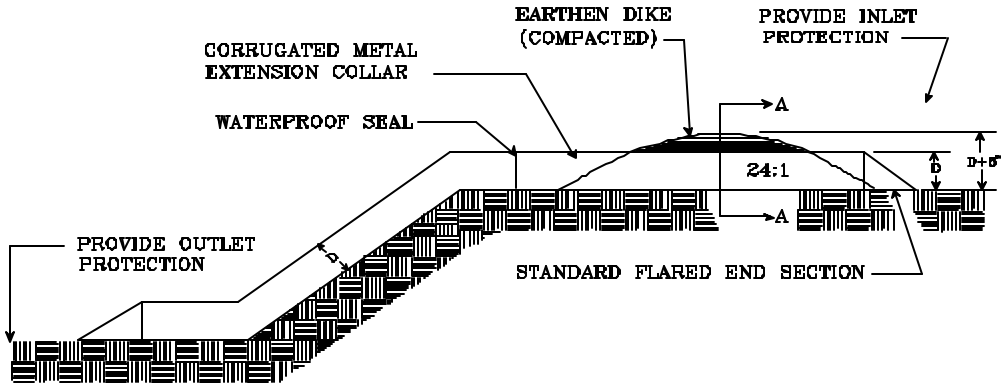
5. The slope drain sections shall be securely fastened together and have watertight fittings.

6. Install CULVERT INLET PROTECTION and OUTLET PROTECTION as per Std. & Spec.'s 3.08 and 3.18, respectively.

Maintenance

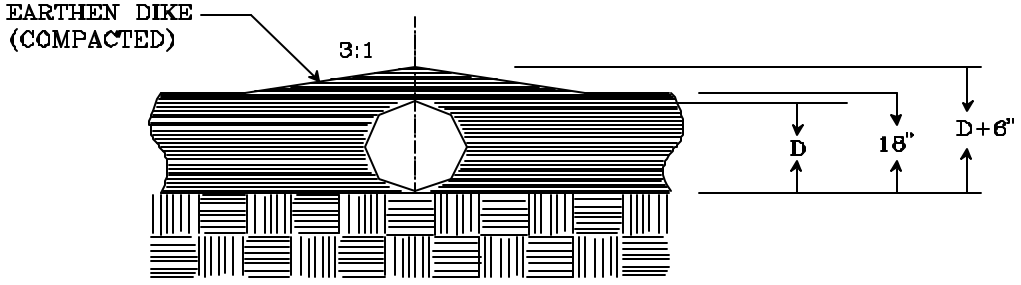
The slope drain structure shall be inspected weekly and after every storm, and repairs made if necessary. The contractor should avoid the placement of any material on and prevent construction traffic across the slope drain.

TEMPORARY SLOPE DRAIN



SECTION VIEW

NOTE: SEDIMENT MAY BE CONTROLLED AT OUTLET IF UPLAND PONDING WILL CREATE PROBLEMS



SECTION A – A

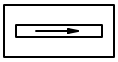
SOURCE: VA. DSWC

PLATE 3.15–1

Table 3.15-A
SIZE OF SLOPE DRAIN

Maximum Drainage Area (acres)	Pipe Diameter (inches)
0.5	12
1.5	18
2.5	21
3.5	24
5.0	30

STD & SPEC 3.17
STORMWATER CONVEYANCE CHANNEL



SCC

Practice Description

A permanent, designed waterway, shaped, sized, and lined with appropriate vegetation or structural material, used to safely convey stormwater runoff within or away from a developing area and to provide for the conveyance of concentrated surface runoff water to a receiving channel or system without damage from erosion.

Conditions Where Practice Applies

Generally applicable to man-made channels, including roadside ditches and intermittent natural channels, which are constructed or are modified to accommodate flows generated by land development.

Construction Specifications

General:

1. All trees, brush, stumps, roots, obstructions and other unsuitable material shall be removed and disposed of properly.

2. The channel shall be excavated or shaped to the proper grade and cross-section.

3. Any fills shall be well compacted to prevent unequal settlement.

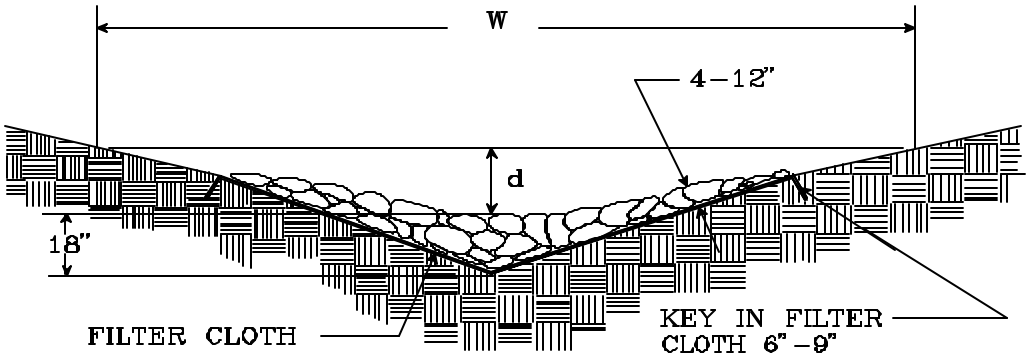
4. Any excess soil shall be removed and disposed of properly.

5. The top width of parabolic and vee-shaped, grass-lined channels shall not exceed 30 feet, and the bottom width of trapezoidal, grass lined channels shall not exceed 15 feet unless multiple or divided waterways, riprap center, or other means are provided to control meandering of low flows.

6. Where there will be a base flow in grass-lined channels, a stone center, a subsurface drain, or other suitable means to handle the base flow shall be provided. Plate 3.17-2 shows typical cross-sections for stone center channels.

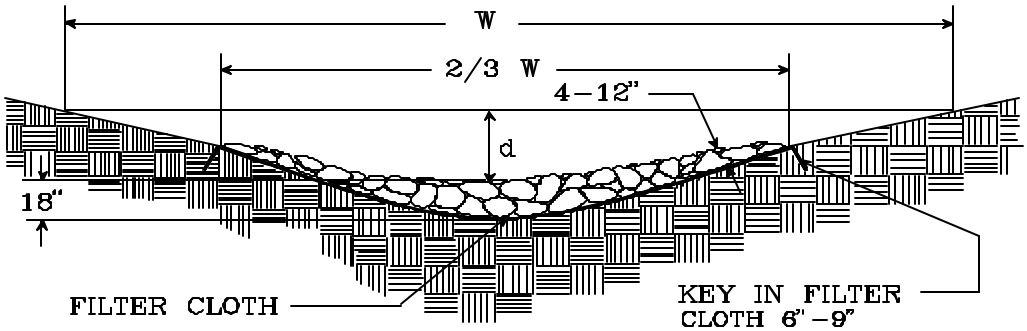
7. The outlets of all channels shall be protected from erosion (see OUTLET PROTECTION**,** Std & Spec. 3.18).

STONE–LINED WATERWAYS



V–SHAPED WATERWAY WITH STONE CENTER DRAIN

NOTE: A GRANULAR FILTER MAY BE SUBSTITUTED FOR FILTER CLOTH



PARABOLIC WATERWAY WITH STONE CENTER DRAIN

NOTE: A GRANULAR FILTER MAY BE SUBSTITUTED FOR FILTER CLOTH.

Source: USDA–SCS

Plate 3.17–2

Grass-lined Channels: The method used to establish grass in the ditch or channel will depend upon the severity of the conditions encountered. The methods available for grass establishment are set forth in PERMANENT SEEDING, Std. & Spec. 3.32, and SODDING, Std. & Spec. 3.33. Below is a table which can be used to help choose a successful grass establishment technique, if any of the four conditions is exceeded, the next establishment technique below must be used.

Table 3.17 - A

GRASS ESTABLISHMENT ALTERNATIVES

Establishment Technique	Conditions
1. (a) Seeding with straw mulch and tack coat. (b) Establishing Bermudagrass by sprigging.	1. Slopes less than 5%. 2. Velocity 3 feet per second or less. 3. Majority of drainage can be diverted away from channel during germination and establishment. 4. Erosion-resistant soils.
2. Seeding with straw mulch and jute mesh or other soil stabilization blankets. (i.e., Treatment-1)	1. Slopes less than 5%. 2. Velocity 4 feet per second or less. 3. Majority of drainage can not be diverted away from channel during germination and establishment. 4. Moderately erodible soil
3. Sodding or use of soil stabilization matting (i.e., Treatment - 2).	1. Slopes greater than 5%. 2. Velocity between 5 feet per second and 6 feet per second. 3. Majority of drainage can not be diverted away from channel during germination and establishment. 4. Highly erodible soil

1. (a) Seeding with straw mulch and tack coat. All seeding shall be done in accordance with PERMANENT SEEDING, Std & Spec. 3.32. When mulching, use 2 tons/acre small grain straw with an acceptable tacking agent. Also refer to MULCHING, Std. & Spec. 3.35.

   (b) Bermudagrass establishment by sprigging. Establish Bermudagrass in accordance with BERMUDAGRASS ESTABLISHMENT, Std. & Spec. 3.34 (E&S Handbook). Irrigation water must be available during the first 4 weeks. Divert drainage away from channel during the first three weeks of the establishment period by using temporary dikes, silt fencing, or straw bale barriers.

2. Seeding with straw mulch and jute mesh or other soil stabilization blankets. In addition to (1a) above, straw mulch may be secured with netting to form a soil stabilization blanket. If using a light plastic or paper erosion netting, 1-1/2 to 2 tons/acre of straw is appropriate. Care should be taken to staple the mesh or blankets according to specifications in, Std. & Spec. 3.36, SOIL STABILIZATION BLANKETS & MATTING, Combination blankets, used alone, are also acceptable mulches for waterways.

3. Sodding or use of Soil Stabilization Matting. Sod shall be installed as per Std & Spec, 3.33. Soil stabilization matting shall be installed as per Std. & Spec 3.36, SOIL STABILIZATION BLANKETS & MATTING.

Riprap-lined Channels
Riprap shall be installed in accordance with RIPRAP, Std. & Spec. 3.19.

Concrete-lined Channels
Concrete-lined channels must be constructed in accordance with all applicable VDOT specifications.

Maintenance

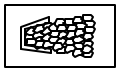
Grass-lined Channels: During the initial establishment, grass-lined channels should be repaired immediately and grass re-established if necessary. After grass has become established, the channel should be checked periodically to determine if the grass is withstanding flow velocities without damage. If the channel is to be mowed, it should be done in a manner that will not damage the grass.
Riprap-lined Channels: Riprap-lined channels should be checked periodically to ensure that scour is not occurring beneath fabric underlining of the riprap layer. The channel should also be checked to determine that the stones are not dislodged by large flows.

Concrete-lined Channels: Concrete-lined channels should be checked periodically to ensure that there is no undermining of the channel. Particular attention should be paid to the outlet of the channel. If scour is occurring at the outlet, appropriate outlet protection shall be installed. See OUTLET PROTECTION, Std. & Spec. 3.18.

Sediment Deposition: If the channel is below a high sediment-producing area, sediment should be trapped before it enters the channel.

Many newly constructed conveyance channels become damaged and require costly repairs as a result of improper upslope controls. If sediment is deposited in a grass-lined channel, it should be removed promptly to prevent damage to the grass. Sediment deposited in riprap and concrete-lined channels should be removed when it reduces the capacity of the channel.

STD & SPEC 3.18
OUTLET PROTECTION



OP

Practice Description

Structurally lined aprons or other acceptable energy dissipating devices placed at the outlets of pipes or paved channel sections, used to prevent scour at stormwater outlets, to protect the outlet structure, and to minimize the potential for downstream erosion by reducing the velocity and energy of concentrated stormwater flows.

Conditions Where Practice Applies

This practice is applicable to the outlets of all pipes and engineered channel sections.

Construction Specifications

1. Apron dimensions: shall be specified in the plan.

2. Bottom grade: The apron shall be constructed with no slope along its length (0.0%grade). The invert elevation of the downstream end of the apron shall be equal to the elevation of the invert of the receiving channel. There shall be no overfall at the end of the apron.

3. Side slopes: If the pipe discharges into a well-defined channel, the side slopes of the channel shall not be steeper than 2:1(horizontal: vertical).

4. Alignment: The apron shall be located so there are not bends in the horizontal alignment.

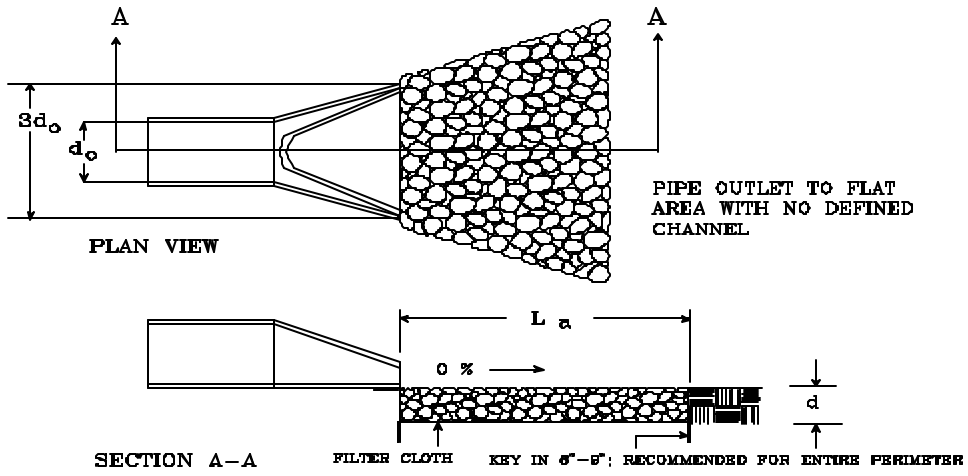
5. Materials: The apron may be lined with riprap, grouted iprap, concrete, or gabion baskets. The median sized stone for riprap shall be specified in the plan. The graduation, quality and placement of riprap shall conform to Std. & Spec. 3.19, RIPRAP.

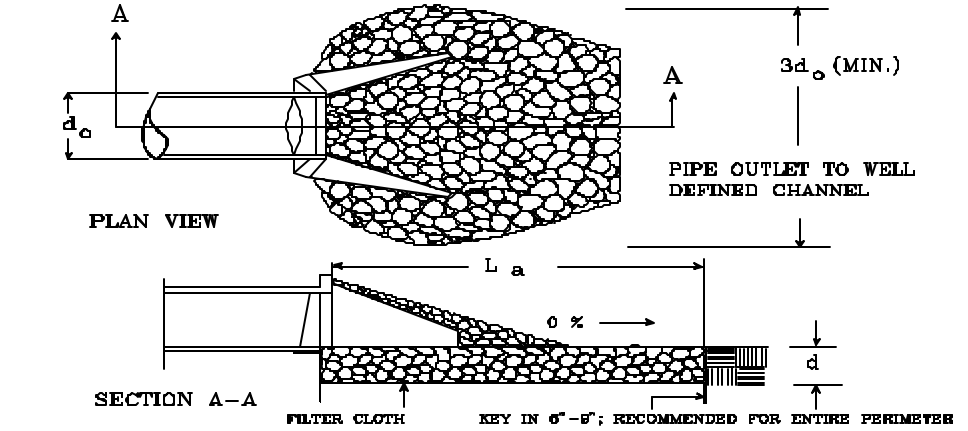
6. Filter cloth: In all cases, filter cloth shall be placed between the riprap and the underlying soil to prevent soil movement into and through the riprap. The material must meet or exceed the physical properties for filter cloth found in Std. & Spec. 3.19, RIPRAP. See Plate 3.18-1 for orientation details.

7. Concrete Aprons: shall be installed according to specifications and details on the plan.

8. Paved Channel Outlets: The end of the paved channel shall merge smoothly with receiving channel section. There shall be no overfall at the end of the paved section. Where the bottom width of the paved channel is narrower than the bottom width of the receiving channel, a transition section shall be provided.

PIPE OUTLET CONDITIONS



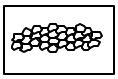


NOTES. 1. APRON LINING MAY BE RIPRAP, GROUTED RIPRAP, GABION BASKET, OR CONCRETE
2. La IS THE LENGTH OF THE RIPRAP APRON AS CALCULATED USING PLATES 3.18–3 AND 3.18–4.
3. d = 1.5 TIMES THE MAXIMUM STONE DIAMETER, BUT NOT LESS THAN 6 INCHES.

Source: Va. DSWC

Plate 3.18–1

STD & SPEC 3.19
RIPRAP



RR

Practice Description

A permanent, erosion-resistant ground cover of large, loose, angular stone with filter fabric or granular underlining, used to protect the soil from the erosive forces of concentrated runoff, slow the velocity of concentrated runoff while enhancing the potential for infiltration; also utilized to stabilize slopes with seepage problems and/or non-cohesive soils.

Conditions Where Practice Applies

Wherever soil and water interface and the soil conditions, water turbulence and velocity, expected vegetative cover, etc., are such that the soil may erode under the design flow conditions. Riprap may be used, as appropriate, at stormdrain outlets, on channel banks and/or bottoms, roadside ditches, drop structures and at the toe of slopes, as transition from concrete channels to vegetated channels.

Construction Specifications

1. Quality of Stone: Stone for riprap shall consist of field stone or rough unhewn quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all respects for the purpose intended.

   Rubble concrete may be used provided it meets the requirements of this standard and specification.

   Size and weight of stone utilized must correspond to plan specifications. The following weight analysis of graded riprap may be used to help verify the class or type of stone which is to be placed:

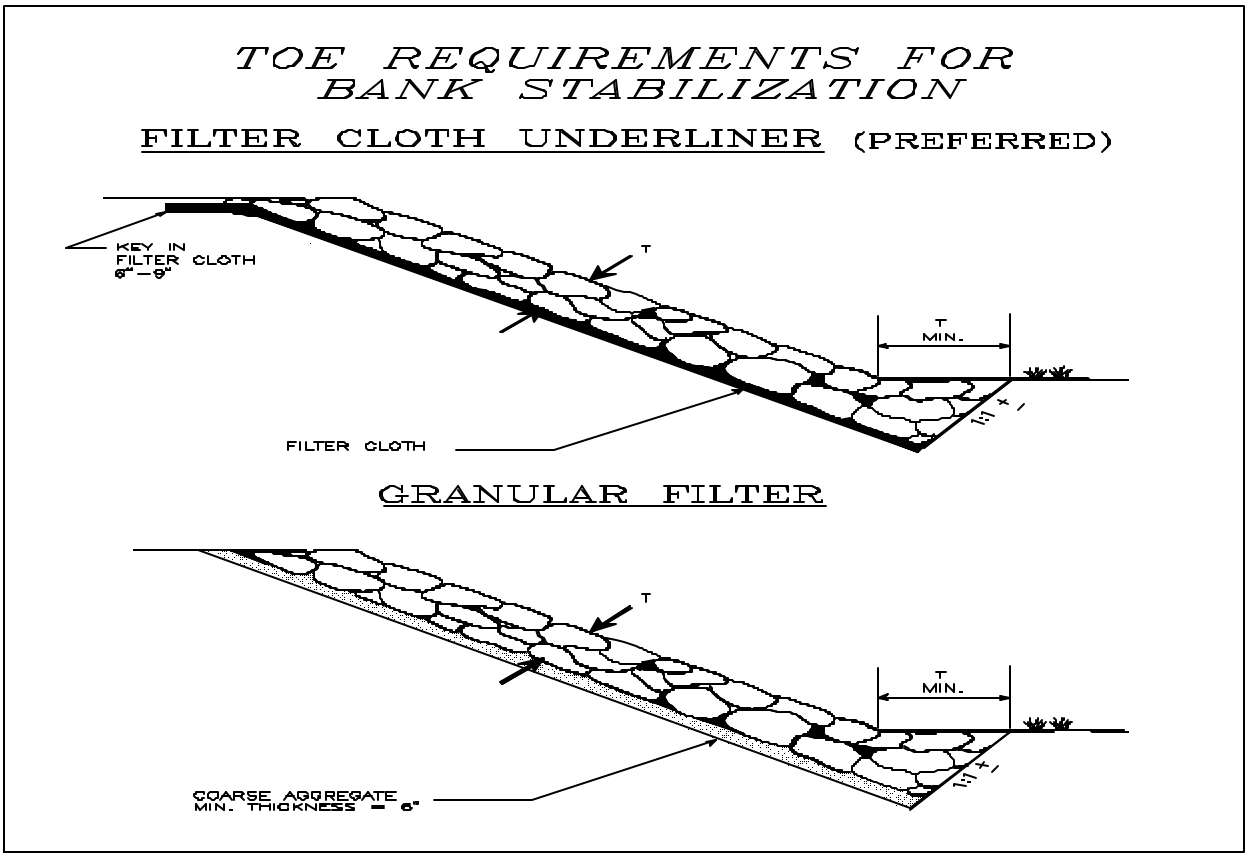
TABLE 3.19 - A
GRADED RIPRAP - WEIGHT ANALYSIS

Riprap Class/Type	Weight Range*(lbs.)	Requirements for Stone Mixture
Class AI	25-75	Max.10% >75 lbs.
Class I	50-150	60% > 100 lbs.
Class II	150-500	50% > 300 lbs.
Class III	500-1,500	50% > 900 lbs.
Type I	1,500-4,000	Av. wt.=2,000lbs.
Type II	6,000-20,000	Av. wt.=8,000lbs.

Source: Adapted from VDOT Road and Bridge Specifications

2. Subgrade Preparation: The subgrade for the riprap or filter shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density approximately that of the surrounding undisturbed material. Brush, trees, stumps and other objectionable material shall be removed.

3. Filter Fabric or Granular Filter: Placement of the filter fabric should be done immediately after slope preparation. For granular filters, the stone should be spread in a uniform layer to the specified depth (normally 6 inches). Where more than one layer of filter material is used, the layer should be spread so that there is minimal mixing of the layers. When installing geotextile filter cloths, the cloth should be placed directly on the prepared slope. The edges of the sheets should overlap by at least 12 inches. Anchor pins, 15 inches long, should be spaced every 3 feet along the overlap. The upper and lower ends of the cloth should be buried at least 12 inches. Care should be taken not to damage the cloth when placing the riprap. If damage occurs, that sheet should be removed and replaced. For large stone (Class II or greater), a 6-inch layer of granular filter will be necessary to prevent damage to the cloth.



SOURCE: Adapted from VDOT Drainage Manual PLATE 3.19–1

Stone Placement: Placement of riprap should follow immediately after placement of the filter. The riprap should be placed so that it produces a dense well-graded mass of stone with a minimum of voids. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry, controlled dumping of successive loads during final placing, or by a combination of these methods.

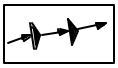
The riprap should be placed to its full thickness in one operation. The riprap should not be placed in layers. The riprap should not be placed by dumping into chutes or similar methods that are likely to cause segregation of the various stone sizes. Care should be taken not to dislodge the underlying material when placing the stones.

The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve the required grades and a good distribution of stone sizes. Final thickness of the riprap blanket should be within plus or minus 1/4 of the specified thickness.

Maintenance

Once a riprap installation has been completed, it should require very little maintenance. It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap or filter fabric or dislodged any of the stone. Care must be taken to properly control sediment-laden construction runoff which may drain to the point of the new installation. If repairs are needed, they should be accomplished immediately.

STD & SPEC 3.20
ROCK CHECK DAMS



CD

Practice Description

Small temporary stone dams constructed across a swale or drainage ditch, to reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch. This practice also traps sediment generated from adjacent areas or the ditch itself, mainly by ponding of the stormwater runoff. Field experience has shown it to perform more effectively than silt fence or straw bales in the effort to stabilize "wet-weather" ditches.

Conditions Where Practice Applies

This practice, utilizing a combination of stone sizes, is limited to use in small open channels that drain 10 acres or less. It should not be used in a live stream as the objective should be to protect the live watercourse. Some specific applications include:

1. Temporary ditches or swales that because of their short length of service, cannot receive a non-erodible lining but still need protection to reduce erosion.

2. Permanent ditches or swales, which for some reason, cannot receive a permanent non-erodible lining for an extended period of time.

3. Either temporary or permanent ditches or swales which need protection during the establishment of grass linings.

4. An aid in the sediment trapping strategy for a construction site.

This practice is not a substitute for major perimeter trapping measures such as a SEDIMENT TRAP (Std. & Spec. 3.13) or a SEDIMENT BASIN (Std. & Spec. 3.14).

Construction Specifications

1. The drainage area of the ditch or swale being protected shall not exceed 2 acres when VDOT #1 Coarse Aggregate is used alone and shall not exceed 10 acres when a combination of Class I Riprap (added for stability) and VDOT #1 Coarse Aggregate is used. Refer to Plate 3.20-1 for orientation of stone and a cross-sectional view of the measure. An effort should be made to extend the stone to the top of channel banks.

2. However, the maximum height of the dam shall be 3.0 feet.

3. The center of the check dam must be at least 6 inches lower than the outer edges. Field experience has shown that many dams are not constructed to promote this "weir" effect. Stormwater flows are then forced to the stone-soil interface, thereby promoting scour at that point and subsequent failure of the structure to perform its intended function.

4. For added stability, the base of the check dam can be keyed into the soil approximately 6 inches.

5. The maximum spacing between the dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam (see Plate 3.20-2).

6. Stone should be placed according to the configuration in Plate 3.20-1. Hand or mechanical placement will be necessary to achieve complete coverage of the ditch or swale and to insure that the center of the dam is lower than the edges.

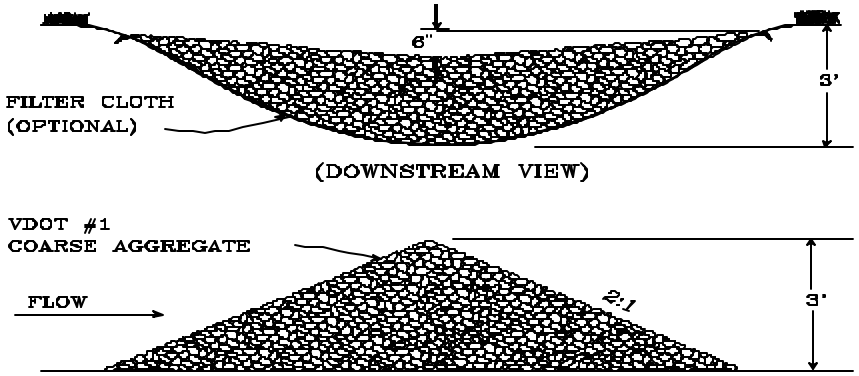
7. Filter cloth may be used under the stone to provide a stable foundation and to facilitate the removal of the stone. See Std. and Spec. 3.19, RIPRAP, for required physical properties of the filter cloth.

Sediment Removal

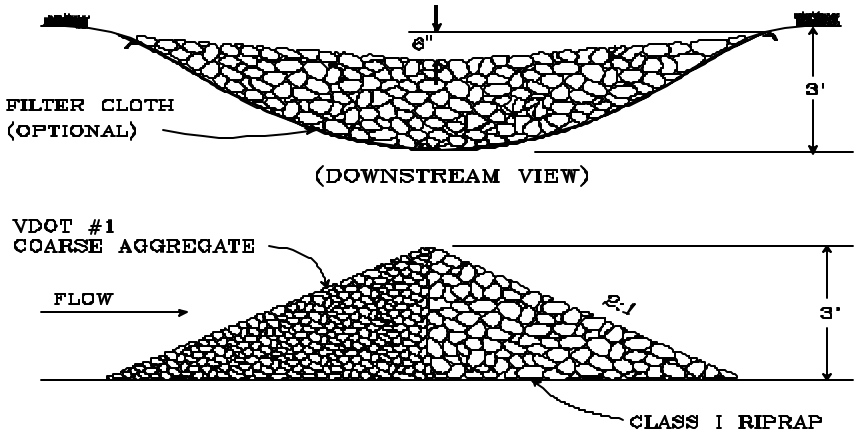
Sediment should be removed from behind the check dam when it has accumulated to one half of the original height of the dam.

ROCK CHECK DAM

2 ACRES OR LESS OF DRAINAGE AREA:

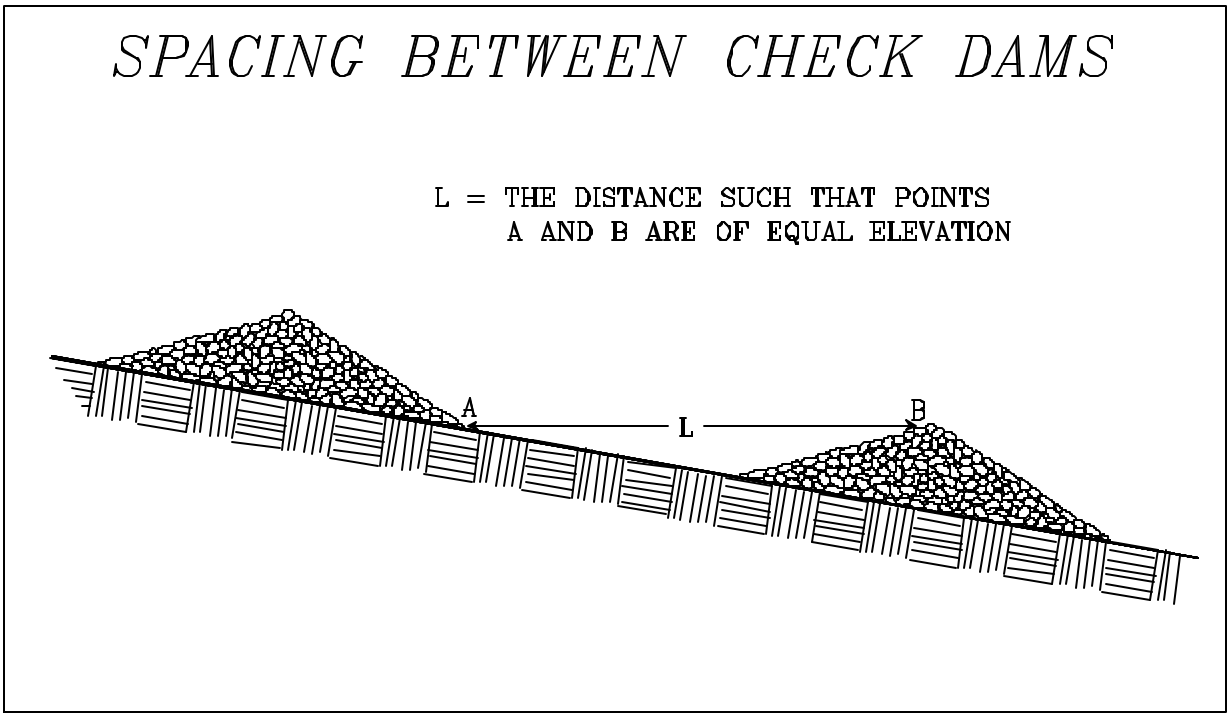


2—10 ACRES OF DRAINAGE AREA:



SOURCE: VA. DSWC

PLATE. 3.20—1



SOURCE: VA. DSWC PLATE. 3.20-2

Removal of Practice

Unless they will be incorporated into a permanent stormwater management control, check dams must be removed when their useful life has been completed. In temporary ditches and swales, check dams should be removed and the ditch filled in when they are no longer needed. In permanent structures, check dams should be removed when a permanent lining can be installed. In the case of grass-lined ditches, check dams should be removed when the grass has matured sufficiently to protect the ditch or swale. The area beneath the check dams should be seeded and mulched immediately after they are removed. The use of filter cloth underneath the stone will make the removal of the stone easier.

Maintenance

Check dams should be checked for sediment accumulation after each runoff-producing storm event. Sediment should be removed when it reaches one half of the original height of the measure. Regular inspections should be made to insure that the center of the dam is lower than the edges. Erosion caused by high flows around the edges of the dam should be corrected immediately.

STD & SPEC 3.24
TEMPORARY VEHICULAR STREAM CROSSING

SC

Practice Description

A temporary structural span installed across a flowing watercourse for use by construction traffic. Structures may include bridges, round pipes, pipe arches, or oval pipes, which provide a means for construction traffic to cross flowing streams without damaging the channel or banks, and keep sediment generated by construction traffic out of the stream.

Conditions Where Practice Applies

Generally applicable to flowing streams with drainage areas less than 1 square mile. Structures that must handle flow from larger drainage areas should be designed by methods that more accurately define the actual hydrologic and hydraulic parameters that will affect the functioning of the structure.

Construction Specifications

Temporary Culvert Crossing

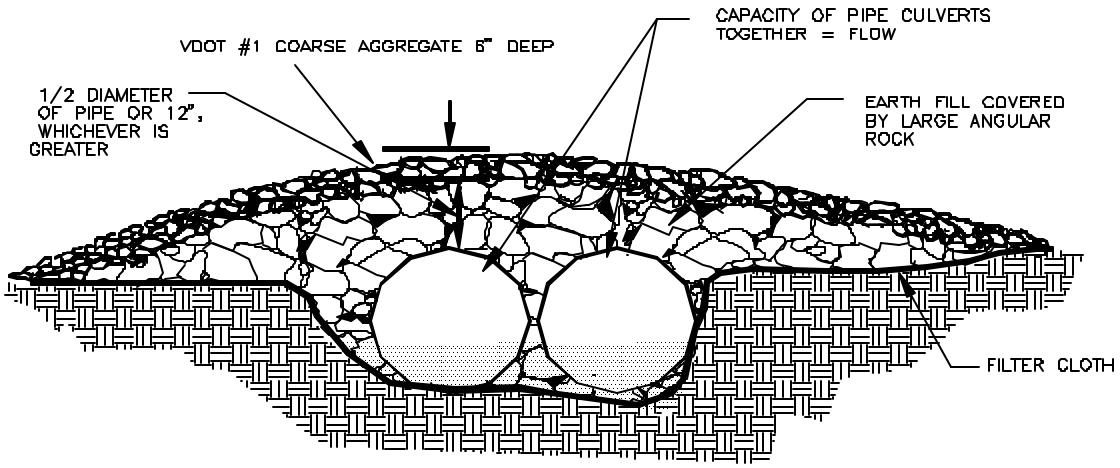
a. Clearing and excavation of the stream bed and banks shall be kept to a minimum.

b. The invert elevation of the culvert shall be installed on the natural streambed grade to minimize interference with fish migration.

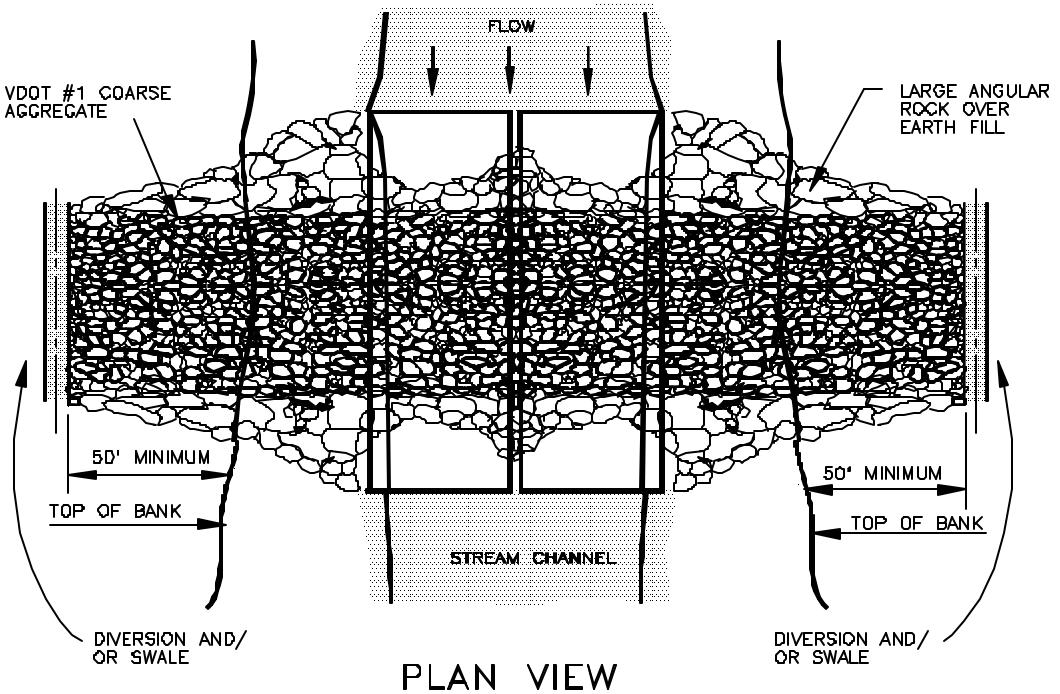
c. Filter cloth shall be placed on the streambed and streambanks prior to placement of the pipe culvert(s) and aggregate. The filter cloth shall cover the streambed and extend a minimum of six inches and a maximum of one foot beyond the end of the culvert and bedding material. Filter cloth reduces settlement and improves crossing stability. See Std. & Spec. 3.19, RIPRAP, for required physical qualities of the filter cloth.

d. The culvert(s) shall extend a minimum of one foot beyond the upstream and downstream toe of the aggregate placed around the culvert. In no case shall the culvert exceed 40 feet in length .

TEMPORARY CULVERT CROSSING



ELEVATION



PLAN VIEW

SOURCE: VA. DSWC

PLATE. 3.24-2

e. The culvert(s) shall be covered with a minimum of one foot of aggregate. If multiple culverts are used, they shall be separated by at least 12 inches of compacted aggregate fill. At a minimum, the bedding and fill material used in the construction of the temporary access culvert crossings shall conform with the aggregate requirements cited in part "i" under "Temporary Culvert Crossing."

f. When the crossing has served its purpose, all structures including culverts, bedding and filter cloth materials shall be removed. Removal of the structure and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

g. Upon removal of the structure, the stream shall immediately be shaped to its original cross-section and properly stabilized.

Maintenance

Structures shall be inspected after every rainfall and at least once a week, whether it has rained or not, and all damages repaired immediately.

STD & SPEC 3.25
UTILITY STREAM CROSSING

USC

Practice Description

A strategy for crossing small waterways when in-stream utility construction is involved; utilized to help protect sediment from entering the stream from construction within approach areas and to minimize the amount of disturbance within the stream itself.

Conditions Where Practice Applies

Practice generally applicable to flowing streams with drainage areas less than one square mile. Structures or methodology for crossing streams with larger drainage areas should be designed by methods that more accurately define the actual hydrologic and hydraulic parameters that will affect the functioning of the structure.

Construction Specifications

1. Diversion Channel Crossing - Preferred method if construction will remain in area of stream for an extended period (longer than 72 hours) and site conditions (such as width of stream) make diversion practical.

    a. The diversion channel crossing must be operational before work is done in the stream (construction will be performed "in the dry").

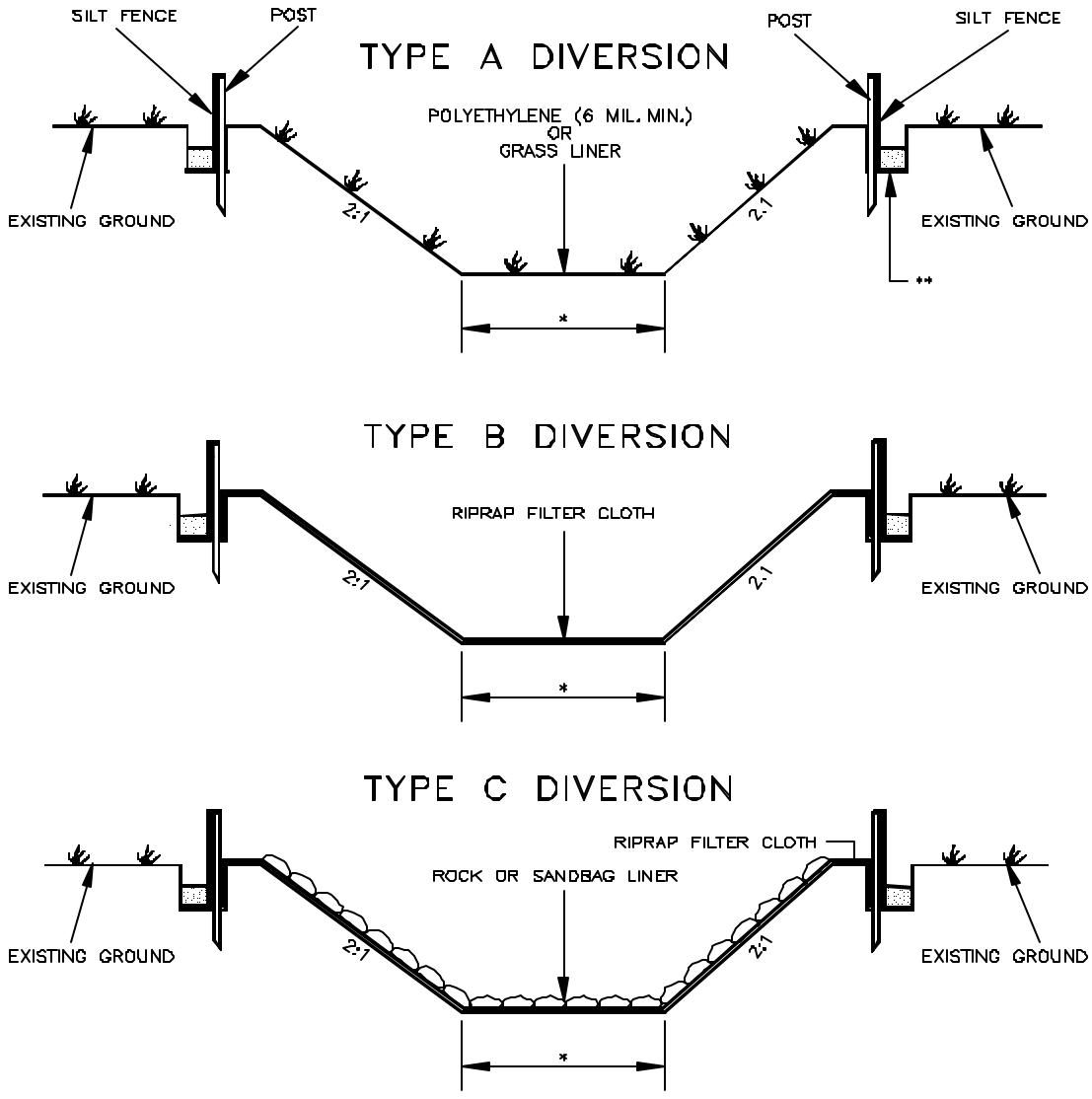
    b. Minimum width of bottom shall be six feet or equal to bottom width of existing streambed, whichever is greater. Refer to Plate 3.25-2.

    c. Maximum steepness of side slopes shall be 2:1. Depth and grade may be variable, dependent on site conditions, but shall be sufficient to ensure continuous flow of water in the diversion.

    d. There are three types of diversion channel linings that can be used, based upon expected velocity of bankfull flow. Refer to Plate 3.25-2 and the following table:

DIVERSION CHANNEL CROSSING

ACCEPTABLE LININGS
(CROSS SECTION A–A OF PLATE 3.25–1)



* 8' MINIMUM OR WIDTH OF EXISTING STREAM WHICHEVER IS LESS

** ENTRENCH SILT FENCE AND FILTER CLOTH IN SAME TRENCH

SOURCE: ADAPTED FROM VDOT STANDARDS

PLATE. 3.25–2

TABLE 3.25-A
DIVERSION CHANNEL LININGS

Lining Material	Classifications	Velocity
Filter Cloth*, Polyethylene or Grass	TYPE A	0 - 2.5 f.p.s
Filter Cloth*	TYPE B	2.5 - 9.0 f.p.s.
Class I Riprap and Filter Cloth*	TYPE C	9.0 - 13.0 f.p.s.

* Filter Cloth must meet the minimum physical requirements in Std. & spec. 3.19, RIPRAP.

e. Type A stream diversions may be seeded with a standard seed mix for the type of soils encountered and the time of year seed is sown. An average growth of two inches in height shall be achieved throughout the diversion with an 85% cover before water is turned through it.

f. Stream diversion liners shall be secured at the upstream and downstream sides with non-erodible weights such as riprap. These weights shall allow normal flow of the stream. Soil shall not be mixed in with stream diversion weights. Weights may also be needed along the stream diversion's length to secure liner.

g. Stream diversion liners should be overlapped when single or continuous liner is not available or is impractical. Overlaps should be such that continuous flow of the steam is maintained. An upstream section should overlap a downstream section by a minimum of 18 inches. Overlaps along the cross-section should be made such that a liner is placed in the steam diversion bottom first and additional pieces of liner on the slopes overlap the bottom piece by a minimum of 18 inches.

h. Stream diversion liners shall be entrenched at the top of the diversion slopes (slopes breaks) along with a line of silt fence. Silt fence may be excluded if the diversion liner is extended to such a point that siltation of the stream will not occur. If silt fence is excluded, the diversion liner must be secured. Liners shall extend from slope break to slope break as shown in Plate 3.25-2.

i. Staples used in securing SOIL STABILIZATION BLANKETS AND MATTING (see Std. & Spec. 3.36) or non-erodible weights (riprap) shall be used as necessary to anchor stream diversion liners to the side slopes of the diversion. Wooden stakes should not be used on the diversion's bottom or side slopes.

j. Non-erodible materials such as riprap, jersey barriers, sandbags, plywood, or sheet piling, shall be used as flow barriers to divert the stream away from its original channel and to prevent or reduce water backup into a construction area.

k. The downstream flow barrier is to be removed prior to the upstream barrier when opening a stream diversion for the transport of water.

l. Streams should be rediverted upon completion of the utility crossing for which the diversion was built. Prior to rediversion, any materials (flow barrier) used to prevent water backup into the downstream end of the original streambed shall be removed. This material should not be placed in the downstream end of the diversion until after water has been rediverted to the original waterway. The stream should then be rediverted by removing all of the materials damming the upstream end of the original streambed and then placing it in the upstream end of the stream diversion. The diversion should be sealed off at the downstream end and then backfilled. Once started, any work to relocate a stream shall not be discontinued until it is completed.

m. Stream should be rediverted only after backfilling and restabilization of original streambed and banks is completed. Restabilization shall consist of the installation of ungrouted riprap on all disturbed streambank areas (or on the area 6 feet on both sides of the centerline of its utility trench, whichever is greater) with slopes of 3:1 or greater. Refer to Std. & Spec. 3.19, RIPRAP, for installation requirements. For slopes of 3:1 or less, vegetative stabilization may be used, pending approval by the Plan-Approving Authority or inspection authority.

   Stabilization of its streambed and banks and the approach areas should occur immediately following the attainment of final grade.

n. Any dewatering discharge from this operation shall be placed into an approved DEWATERING STRUCTURE (see Std. & Spec. 3.26).

2. Cofferdam Utility Crossing - To be used when stream diversion is not practical and stream is wide enough (10 feet or wider) to make cofferdam installation practical.

   a. Construction is to be performed in low flow periods.

   b. Crossing shall be accomplished in a manner that will not prohibit the flow of the stream. (see Plate 3.25-4).

   c. As with all utility line crossings, approach areas must be controlled with perimeter measures such as silt fence or straw bales.

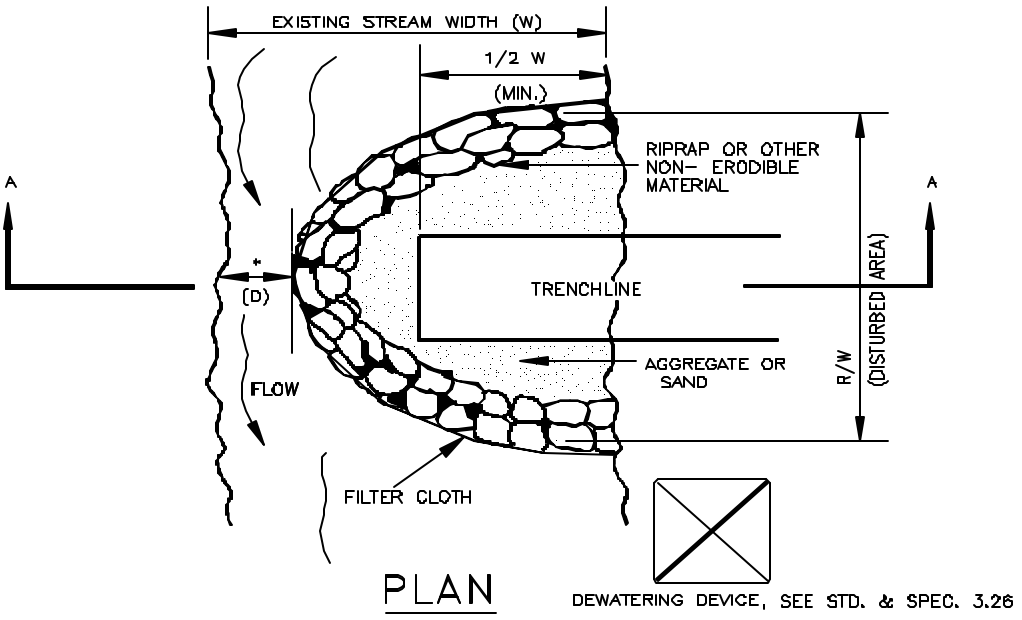
   d. Remove large rocks, woody vegetation, or other material from the streambed and banks that may get in the way of placing the riprap, sandbags, sheet metal, or wood planks or installing the utility pipe or line.

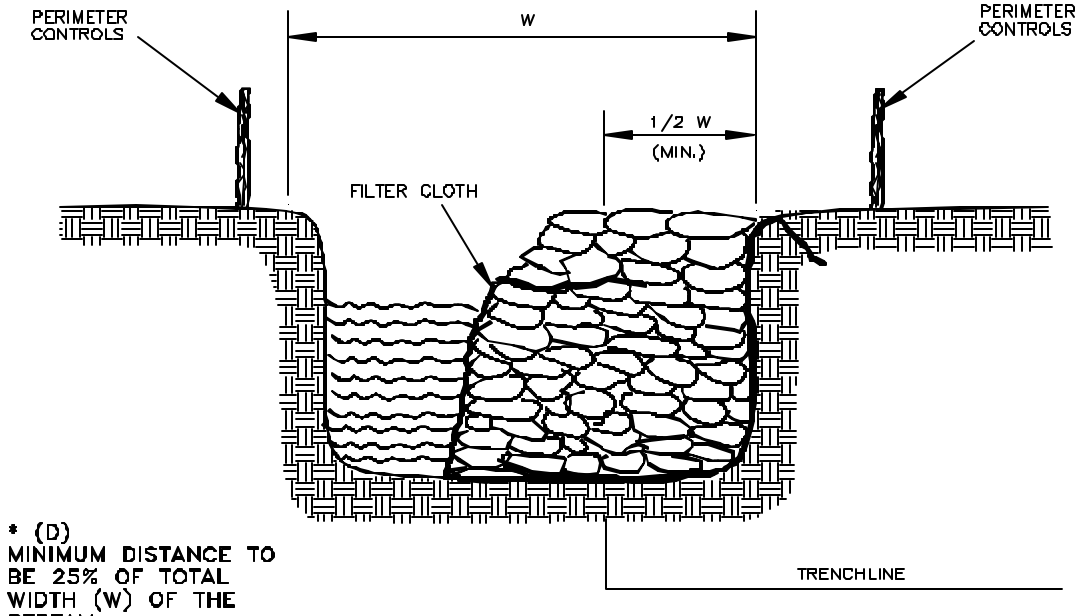
e. Form a cofferdam by placing the riprap (or other non-erodible materials) in a semicircle along the side of the stream in which the utility installation will begin. It must be surrounded and underlain with filter cloth as shown in Plate 3.25-4. The height of and area within the dam will depend upon the size of the work area and the amount of steam flow. Stack materials as high as will be necessary to keep water from overtopping the dam and flooding the work area. When the stream flow is successfully diverted by the cofferdam, dewater the work area and stabilize it with aggregate (VDOT #57 or #68 Coarse Aggregate) or sand. Make sure to discharge the water into a sediment trapping device (see DEWATERING STRUCTURE, Std. & Spec. 3.26).

f. Install the utility pipe or line in half the streambed as noted in Plate 3.25-4. Remove the riprap or other materials and begin placing them on the other side of the stream.

g. Restabilization shall consist of the installation of ungrouted riprap on all disturbed streambank areas (or on the area 6 feet on both sides of the centerline of its utility trench, whichever is greater) with slopes of 3:1 or greater. Refer to Std. & Spec. 3.19, RIPRAP, for installation requirements. For slopes of 3:1 or less, vegetative stabilization may be used, pending approval by Plan-Approving Authority or inspection authority. Stabilization of its streambed and banks and the approach areas should occur immediately following the attainment of final grade.

COFFERDAM CROSSING





* (D)
MINIMUM DISTANCE TO BE 25% OF TOTAL WIDTH (W) OF THE STREAM.

SECTION A–A

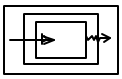
SOURCE: FORD, BACON, & DAVIS, INC.

PLATE. 3.25-4

Maintenance

Care must be taken to inspect any stream crossing area at the end of each day to make sure that the construction materials are positioned securely. This will ensure that the work area stays dry and that no construction materials float downstream.

STD & SPEC 3.26
DEWATERING STRUCTURE



DS

Practice Description

A temporary settling and filtering device for water which is discharged from dewatering activities, used to filter sediment-laden water prior to the water being discharged off-site.

Conditions Where Practice Applies

Wherever sediment-laden water must be removed from a construction site by means of pumping.

Construction Specifications

1. Portable Sediment Tank (see Plate 3.26-1)

   a. The structure may be constructed with steel drums, sturdy wood or other material suitable for handling the pressure exerted by the volume of water.

   b. Sediment tanks will have a minimum depth of two feet.

   c. The sediment tank shall be located for easy clean-out and disposal of the trapped sediment and to minimize the interference with construction activities.

   d. The following formula shall be used to determine storage volume of the sediment tank:

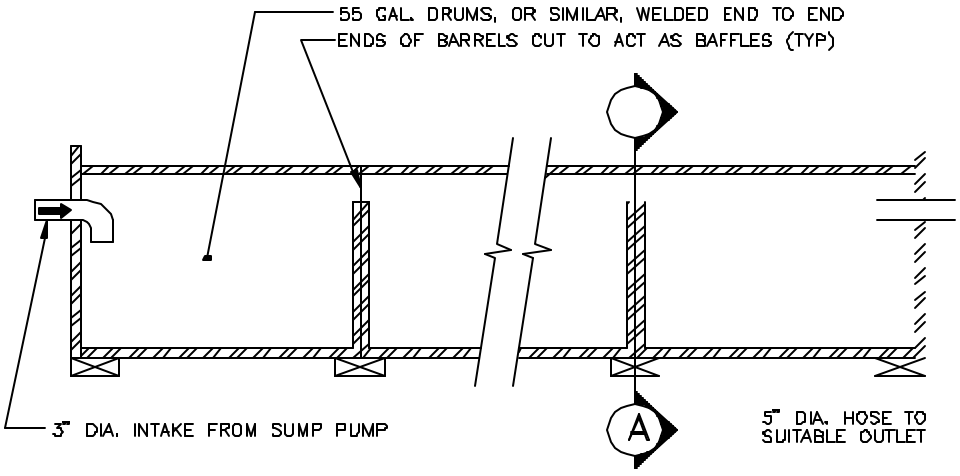
      Pump discharge (g.p.m.) x 16 = cubic feet of storage required.

   e. Once the water level nears the top of the tank, the pump must be shut off while the tank drains and additional capacity is made available.

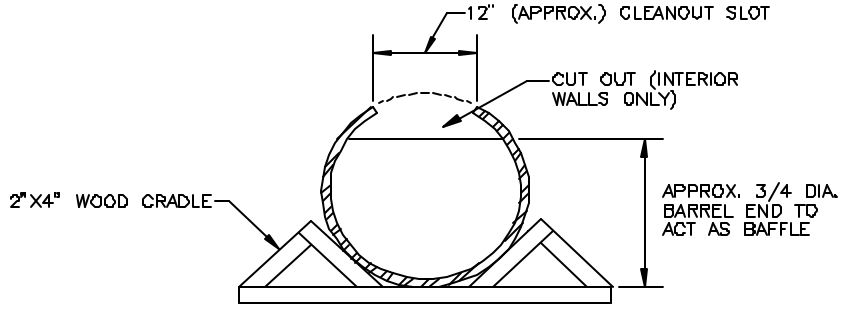
   f. The tank shall be designed to allow for emergency flow over top of the tank.

   g. Clean-out of the tank is required once one-third of the original capacity is depleted due to sediment accumulation. The tank shall be clearly marked showing the clean-out point.

PORTABLE SEDIMENT TANK



ELEVATION



CROSS–SECTION A–A

SOURCE: USDA – SCS

PLATE: 3.26–1

2. Straw Bale/Silt Fence Pit (see Plate 3.26-3)

a. Measure shall consist of straw bales, silt fence, a stone outlet (a combination of VDOT Class AI Riprap and VDOT #25 or #26 Aggregate) and a wet storage pit oriented as shown in Plate 3.26-3.

b. The structure must have a capacity that is dictated by the following formula:

Pump discharge (g.p.m.) x 16 = cubic feet of storage required.

In calculating the capacity, one should include the volume available from the floor of the excavation to the crest of the stone weir.

c. In any case, the excavated area should be a minimum of 3 feet below the base of the perimeter measures (straw bales or silt fence).

d. The perimeter measures must be installed as per the guidelines found in Std. & Spec. 3.04, STRAW BALE BARRIER and Std. & Spec. 3.05, SILT FENCE.

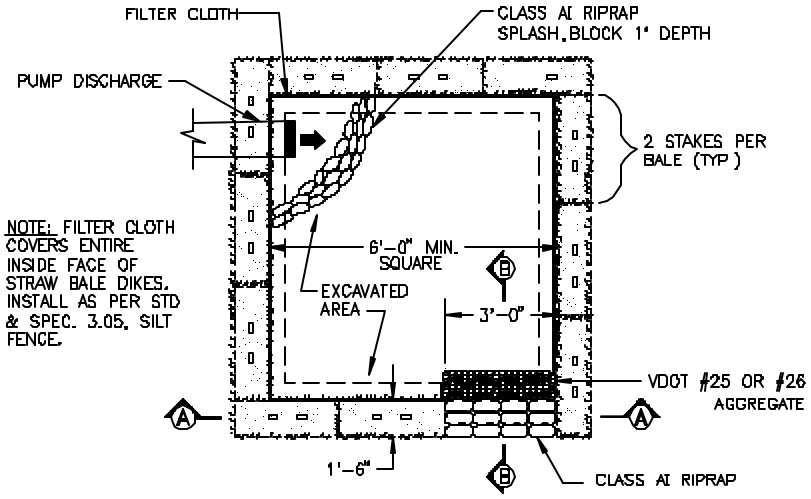
e. Once the water level nears the crest of the stone weir (emergency overflow), the pump must be shut off while the structure drains down to the elevation of the wet storage.

f. The wet storage pit may be dewatered only after a minimum of 6 hours of sediment settling time. This effluent should be pumped across a well-vegetated area or through a silt fence prior to entering a watercourse.

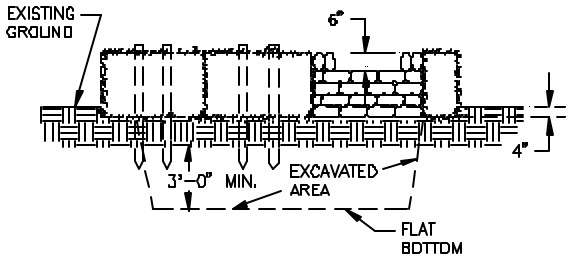
g. Once the wet storage area becomes filled to one-half of the excavated depth, accumulated sediment shall be removed and properly disposed of.

h. Once the device has been removed, ground contours will be returned to original condition.

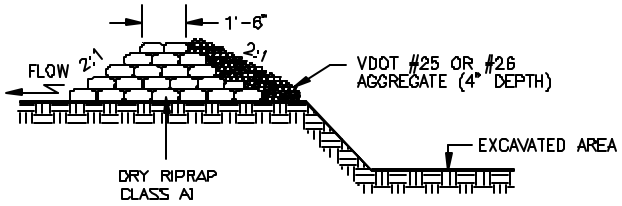
STRAW BALE/SILT FENCE PIT



PLAN VIEW



CROSS-SECTION A-A



CROSS-SECTION B-B

SOURCE: Va. DSWC

PLATE: 3.26-3

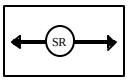
Maintenance

(All dewatering structures)

1. The filtering devices must be inspected frequently and repaired or replaced once the sediment build-up prevents the structure from functioning as designed.

2. The accumulated sediment that is removed from a dewatering device must be spread on-site and stabilized or disposed of at an approved disposal site as per approved plan.

STD & SPEC 3.29
SURFACE ROUGHENING



SR

Practice Description

Providing a rough soil surface with horizontal depressions created by operating a tillage or other suitable implement on the contour, or by leaving slopes in a roughened condition by not fine-grading them, to aid in establishment of vegetative cover with seed, reduce runoff velocity and increase infiltration, and to reduce erosion and provide for sediment trapping.

Conditions Where Practice Applies

1. All slopes steeper than 3:1 require surface roughening, either stair-step grading, grooving, furrowing, or tracking if they are to be stabilized with vegetation.

2. Areas with grades less steep than 3:1 should have the soil surface lightly roughened and loose to a depth of 2 to 4 inches prior to seeding.

3. Areas which have been graded and will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.

4. Slopes with a stable rock face do not require roughening or stabilization.

Specifications

Cut Slope Applications For Areas Which Will Not Be Mowed

Cut slopes with a gradient steeper than 3:1 shall be stair-step graded or grooved (Plates 3.29-1 and 3.29-2).

1. Stair-step grading may be carried out on any material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.

   The ratio of the vertical cut distance to the horizontal distance shall be less than 1:1 and the horizontal portion of the "step" shall slope toward the vertical wall. Individual vertical cuts shall not be more than 30 inches on soft soil materials and not more than 40 inches in rocky materials.

2. Grooving consists of using machinery to create a series of ridges and depressions which run perpendicular to the slope (on the contour).

   Grooves may be made with any appropriate implement which can be safely operated on the slope and which will not cause undue compaction. Suggested implements include discs, tillers, spring harrows, and the teeth on a front-end loader bucket. Such grooves shall not be less than 3 inches deep nor further than 15 inches apart.

Fill Slope Applications For Areas Which Will Not Be Mowed

Fill slopes with a gradient steeper than 3:1 shall be grooved or allowed to remain rough as they are constructed. Method (1) or (2) below may be used.

1. Groove according to #2 above.

2. As lifts of the fill are constructed, soil and rock materials may be allowed to fall naturally onto the slope surface.

   Colluvial materials (soil deposits at the base of slopes or from old stream beds) shall not be used in fills as they flow when saturated.

   At no time shall slopes be bladed or scraped to produce a smooth, hard surface.

Cuts, Fills, and Graded Areas Which Will Be Mowed

Mowed slopes should not be steeper than 3:1. Excessive roughness is undesirable where mowing is planned. These areas may be roughened with shallow grooves such as remain after tilling, discing, harrowing, raking, or use of a cultipacker-seeder. The final pass of any such tillage implement shall be on the contour (perpendicular to the slope).

Grooves formed by such implements shall be not less than 1-inch deep and not further than 12-inches apart. Fill slopes that are left rough as constructed may be smoothed with a dragline or pickchain to facilitate mowing.

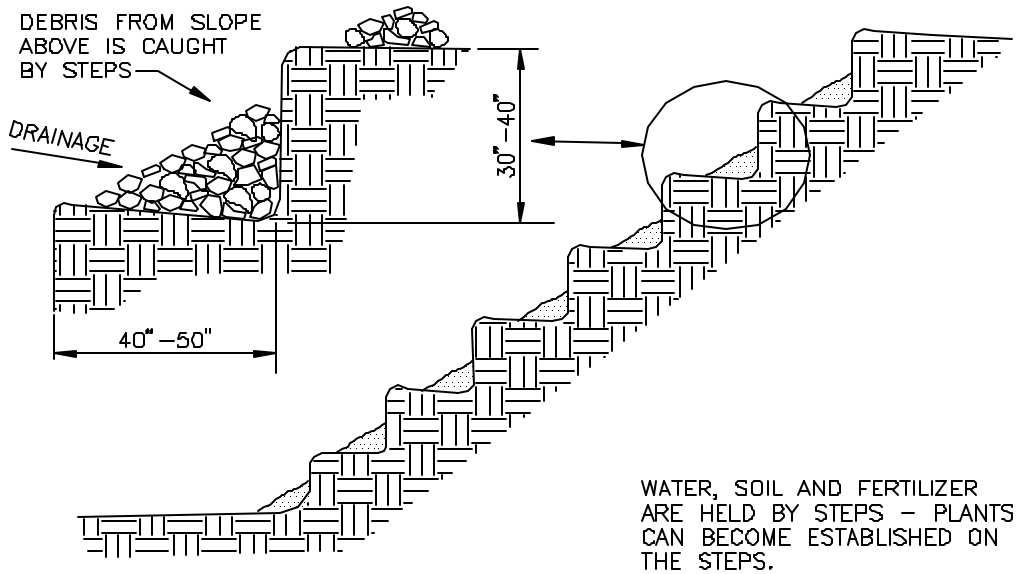
Roughening With Tracked Machinery

Roughening with tracked machinery on clayey soils is not recommended. Undue compaction of surface soil results from this practice. Sandy soils do not compact severely, and may be tracked. When tracking is the chosen surface roughening technique, it shall be done by operating tracked machinery **up and down the slope** to leave horizontal depressions in the soil. As few passes of the machinery should be made as possible to minimize compaction.

Seeding

Roughened areas shall be seeded and mulched as soon as possible to obtain optimum seed germination and seedling growth.

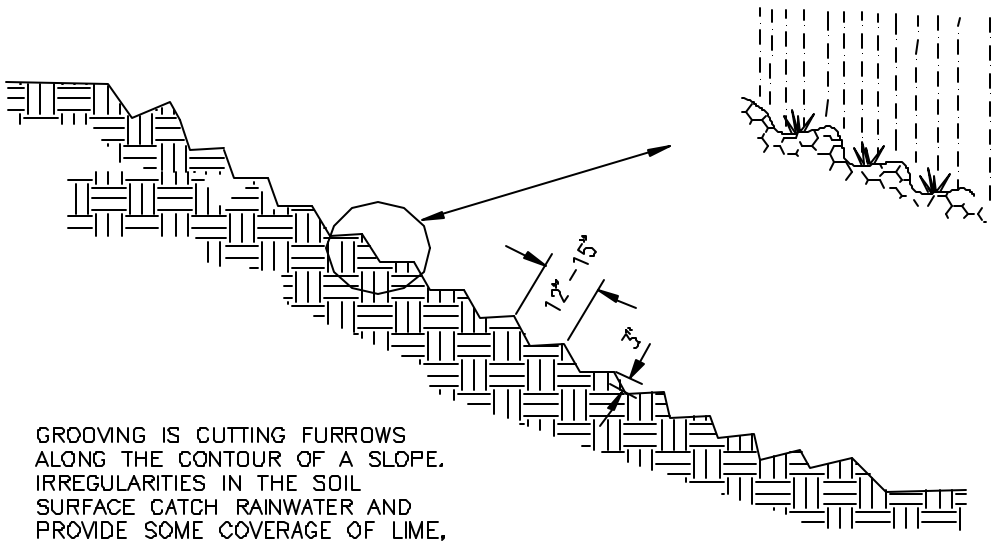
STAIR STEPPING CUT SLOPES



SOURCE: VA. DSWC

PLATE 3.29-1

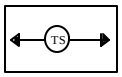
GROOVING SLOPES



SOURCE: VA. DSWC

PLATE 3.29-2

STD & SPEC 3.31
TEMPORARY SEEDING



TS

Practice Description

The establishment of a temporary vegetative cover on disturbed areas by seeding with appropriate rapidly growing annual plants; employed to reduce erosion and sedimentation by stabilizing disturbed areas that will not be brought to final grade for a period of more than 30 days, to reduce damage from sediment and runoff to downstream or off-site areas, and to provide protection to bare soils exposed during construction until permanent vegetation or other erosion control measures can be established.

Conditions Where Practice Applies

Where exposed soil surfaces are not to be fine-graded for periods longer than 30 days. Such areas include denuded areas, soil stockpiles, dikes, dams, sides of sediment basins, temporary roadbanks, etc. (see MS #1 and MS #2). A permanent vegetative cover shall be applied to areas that will be left dormant for a period of more than 1 year.

Specifications

Plant Selection

Select plants that are appropriate to the season and site conditions. An extensive description of some of the plants that are commonly utilized for temporary seeding can be found in Appendix 3.31-a.

Seedbed Preparation: To control erosion on bare soil surfaces, plants must be able to germinate and grow. Seedbed preparation is essential.

1. Liming: An evaluation should be conducted to determine if lime is necessary for temporary seeding. In most soils, it takes up to 6 months for a pH adjustment to occur following the application of lime. Therefore, it may be difficult to justify the cost of liming a temporary site, especially when the soil will later be moved and regraded. The following table may be used to determine the actual need along with suggested application rates.

TABLE 3.31-A
LIMING REQUIREMENTS FOR TEMPORARY SITES

pH Test	Recommended Application
below 4.2	3 tons per acre
4.2 to 5.2	2 tons per acre
5.2 to 6	1 ton per acre

2. Fertilizer: Shall be applied as 600 lbs./acre of 10-20-10 (14 lbs./1,000 sq. ft.) or equivalent nutrients. Lime and fertilizer shall be incorporated into the top 2 to 4 inches of the soil if possible.

3. Surface Roughening: If the area has been recently loosened or disturbed, no further roughening is required. When the area is compacted, crusted, or hardened, the soil surface shall be loosened by discing, raking, harrowing, or other acceptable means (see SURFACE ROUGHENING, Std. & Spec. 3.29).

4. Tracking: Tracking with bulldozer cleats is most effective on sandy soils. This practice often causes undue compaction of the soil surface, especially in clayey soils, and does not aid plant growth as effectively as other methods of surface roughening

Seeding: Seed shall be evenly applied with a broadcast seeder, drill, cultipacker seeder or hydroseeder. Small grains shall be planted no more than 1½ inches deep. Small seeds, such as Kentucky Bluegrass, should be planted no more than 1/4 inch deep. Other Grasses and Legumes should be planted from 1/4 inch to 1/2 inch deep.

Mulching:
1. Seedings made in fall for winter cover and during hot and dry summer months shall be mulched according to MULCHING, Std. & Spec. 3.35, except that hydromulches (fiber mulch) will not be considered adequate. Straw mulch should be used during these periods.
2. Temporary seedings made under favorable soil and site conditions during optimum spring and fall seeding dates may not require mulch.

Re-seeding: Areas which fail to establish vegetative cover adequate to prevent rill erosion will be re-seeded as soon as such areas are identified.

TABLE 3.31-B
ACCEPTABLE TEMPORARY SEEDING PLANT MATERIALS
"QUICK REFERENCE FOR ALL REGIONS"

Planting Dates	Species	Rate (lbs/acre)
Sept. 1 - Feb. 15	50/50 Mix of Annual Ryegrass (Lolium multi-florum) & Cereal (Winter) Rye (Secale cereale)	50 - 100
Feb. 16 - Apr. 30	Annual Ryegrass (Lolium multi-florum)	60 - 100
May 1 - Aug. 31	German Millet (Setaria italica)	50

APPENDIX 3.31 - a
PLANT INFORMATION SHEETS

1. **Oats** (Avenasativa): A cool season annual grass primarily grown for animal feed and human consumption, but also used for soil stabilization. Oats are seeded in early spring in the western part of the state (winter oats may be sown in the Coastal Plain). Seeding rates are 3 bushels (100 lbs.) per acre bare ground or 2-1/2 lbs. per 1000 square feet.

2. **Rye** (Secale cereale): Often referred to as Winter Rye because of its winter hardiness, Rye is the most common small grain used for soil stabilization. It is also the most productive grain on dry, infertile, acid or sandy soils. It may be seeded in the fall for winter ground cover. By maturing early, it offers less competition during the late spring period, a critical time in the establishment of perennial species. Rye grain germinates quickly and is tolerant of poor soils. * Including Rye grain in fall-seeded mixtures is almost always advantageous, but it is particularly helpful on difficult and erodible soils, erodible slopes or when seeding is late. Rates up to 100 lbs. per acre for bare ground. Overly thick stands of Rye grain will suppress the growth of perennial seedlings. Approximately 50 lbs. per acre is the maximum for this purpose and, where lush growth is expected, that rate should either be cut in half or totally eliminated from the mixture.

3. **Foxtail Millet** (Setaria italica): A warm season annual grass which may be used for temporary cover. German Millet (variety commonly used in Virginia) germinates quickly and goes to seed quickly. These features make it an excellent companion grass for summer seedings. It dies at first frost. Seeding rates are up to 50 lbs. per acre for temporary cover. Use 10 to 20 lbs. per acre in mixes.

4. **Annual Rye** (Lolium multiflorum): A cool season annual grass used for temporary cover or as a nurse grass to allow for germination of permanent stands. Most commonly used in mixes for erosion control. Performs well throughout the state in neutral to slightly acid soils. Rates up to 100 lbs. per acre for temporary cover. Use 10 to 20 lbs. per acre in mixes.

5. **Annual Lespedezas** (Lespedeza striata)

   Uses: Pasture, hay, erosion control, soil improvement, wildlife food.

   Description: Annual warm season legumes. Korean Lespedeza is larger and coarser than Common Lespedeza and grows to about 12 inches. Seed of Korean is shiny and black, while seed of Common is stippled. Kobe is the most desirable variety of Common Lespedeza.

   Adaptation: Throughout Virginia. Optimum pH range is 6.0 to 6.5; will grow from 5.5 to 7.0. Will grow in soil textures ranging from sands to clays and though a wide range of fertility conditions.

   Establishment: Seed should always be inoculated. May be seeded alone or mixed with grasses or small grains. Requires a firm seedbed; may be broadcast or drilled. Should be seeded in early spring at 25 to 40 lbs. per acre or one-half to 1 lb. per 1000 square feet, depending on use. (Use lower figure as half

the seeding rate of any spring seeding with grass or grain). Should not be mowed at less than three inches. Lespedeza will not make a large contribution in sod grasses like Bluegrass; they do best in open sod grasses like tall fescue.

6. **Weeping Lovegrass** (Eragrostis curvula)

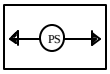
Uses: Fast-growing cover for erosion control. In the northeast, weeping lovegrass acts as a summer annual. The normal life of 3 to 5 years may be foreshortened by low winter temperatures. May provide permanent cover on southern exposure.

Description: A rapid-growing, warm season bunch grass introduced from East Africa. The long, narrow leaves are numerous, very fine, and droop over to the ground, hence the name. Leaf height is rarely above 12 inches.

Adaptation: Prefers light-textured, well-drained soil; will thrive on soil of low fertility. Low winter temperatures may deplete stand.

Establishment: Easy to establish by seed; germinates rapidly and grows quickly. Lime and fertilizer needs are similar to those of Tall Fescue and Ryegrass. Requires pH of 5.5 or higher. May be planted any time after danger of frost and throughout the summer. Very fine seed, commonly added to erosion control seed mixtures. Use of hydroseeders is successful if the seeding rate is increased to compensate for the lack of a firm seedbed. Normal seeding rates are 5 to 20 lbs. per acre in mixes.

STD & SPEC 3.32
PERMANENT SEEDING



PS

Practice Description

The establishment of perennial vegetative cover on disturbed areas by planting seed. It is utilized for the following:

1. To reduce erosion and decrease sediment yield from disturbed areas.

2. To permanently stabilize disturbed areas in a manner that is economical, adaptable to site conditions, and allows selection of the most appropriate plant materials.

3. To improve wildlife habitat.

4. To enhance natural beauty.

Conditions Where Practice Applies

1. Disturbed areas where permanent, long-lived vegetative cover is needed to stabilize the soil.

2. Rough-graded areas which will not be brought to final grade for a year or more.

Specifications

Selection of Plant Materials

1. Selection of plant materials is based on climate, topography, soils, land use, and planting season.

2. An extensive description of some of the plants which are commonly utilized for permanent seeding can sbe found in Appendix 3.32-c. Plate 3.32-1 shows plant hardiness zones for grasses and legumes for Virginia's two major climate regions:

3. Appropriate seeding mixtures for various site conditions in Virginia are given in Tables 3.32-A, 3.32-B and 3.32-C. These mixtures are designed for general use, and are known to perform well on the sites described.

4. When using some varieties of turfgrasses, the Virginia Crop Improvement Association (VCIA) recommended turfgrass mixtures may also be used. Consumer protection programs have been devised to identify quality seed of the varieties recommended by the Virginia Cooperative Extension Service. These will bear a label indicating that they are approved by the Association. Mixtures may be designed for a specific physiographic region or based on intended use. Special consideration is given to plant characteristics, performance, etc.

TABLE 3.32-A
SITE SPECIFIC SEEDING MIXTURES
FOR APPALACHIAN/MOUNTAIN AREA

Minimum Care Lawn	Total Lbs. Per Acre
- Commercial or Residential	200-250 lbs.
- Kentucky 31 or Turf-Type Tall Fescue	90-100%
- Improved Perennial Ryegrass	0-10%
- Kentucky Bluegrass	0-10%

High-Maintenance Lawn	
Minimum of three (3) up to five (5) varieties of bluegrass from approved list for use in Virginia.	125 lbs.

General Slope (3:1 or less)	
- Kentucky 31 Fescue	128 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
	150 lbs.

Low-Maintenance Slope (Steeper than 3:1)	
- Kentucky 31 Fescue	108 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
- Crownvetch **	20 lbs.
	150 lbs.

*Use seasonal nurse crop in accordance with seeding dates as stated below:

March, April through May 15th.....Annual Rye
May 16th through August 15th.....Foxtail Millet
August 16th through September, October.....Annual Rye
November through February..... Winter Rye

**If Flatpea is used, increase to 30 lbs./acre. All legume seed must be properly inoculated. Weeping Lovegrass may also be included in any slope or low- maintenance mixture during warmer seeding periods; add 10-20 lbs./acre in mixes.

TABLE 3.32-B
SITE SPECIFIC SEEDING MIXTURES FOR
PIEDMONT AREA

Minimum Care Lawn.	Total lbs Per Acre
- Commercial or Residential	175-200 lbs.
- Kentucky 31 or Turf-Type Tall Fescue	95-100%
- Improved Perennial Ryegrass	0-5%
- Kentucky Bluegrass	0-5%
High-Maintenance Lawn	200-250 lbs.
Kentucky 31 or Turf-Type Tall Fescue	100%
General Slope (3:1 or less)	
- Kentucky 31 Fescue	128 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
	150 lbs.
Low-Maintenance Slope (Steeper than 3:1)	
- Kentucky 31 Fescue	108 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
- Crownvetch **	20 lbs.
	150 lbs.

*Use seasonal nurse crop in accordance with seeding dates as stated below:

February 16th through April.....Annual Rye
May 1st through August 15th..... Foxtail Millet
August 16th through October.....Annual Rye
November through February 15th..... Winter Rye

**Substitute Sericea lespedeza for Crownvetch east of Farmville, Va.
(May through September use hulled Sericea, all other periods, use unhulled Sericea). If Flatpea is used in lieu of Crownvetch, increase rate to 30 lbs./acre. All legume seed must be properly inoculated. Weeping Lovegrass may be added to any slope or low-maintenance mix during warmer seeding periods; add 10-20 lbs./acre in mixes.

TABLE 3.32-C
SITE SPECIFIC SEEDING MIXTURES
FOR COASTAL PLAIN AREA

Minimum Care Lawn	Total Lbs Per Acre
- Kentucky 31 or Turf-Type Tall Fescue	175-200 lbs.
or	
- Common Bermudagrass **	75 lbs.
High-Maintenance Lawn	
- Kentucky 31 or Turf-Type Tall Fescue	200-250 lbs.
or	
- Hybrid Bermudagrass (seed) **	40 lbs. (unhulled)
or	30 lbs. (hulled)
General Slope (3:1 or less)	
- Kentucky 31 Fescue	128 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
	150 lbs.
Low Maintenance Slope (Steeper than 3:1)	
- Kentucky 31 Tall Fescue	93-108 lbs.
- Common Bermudagrass **	0-15 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop *	20 lbs.
- Sericea Lespedeza **	20 lbs.
	150 lbs.

* Use seasonal nurse crop in accordance with seeding dates as stated below:

February, March through April.....Annual Rye
May 1st through August.....Foxtail Millet
September, October through November 15th.....Annual Rye
November 16th through January.....Winter Rye

** May through October, use hulled seed. All other seeding periods, use unhulled seed. Weeping Lovegrass may be added to any slope or low-maintenance mix during warmer seeding periods; add 10-20 lbs./acre in mixes.

Seedbed Requirements: Vegetation should not be established on slopes that are unsuitable due to inappropriate soil texture, poor internal structure or internal drainage, volume of overland flow, or excessive steepness, until measures have been taken to correct these problems.

To maintain a good stand of vegetation, the soil must meet certain minimum requirements as a growth medium. The existing soil must have these characteristics:

1. Enough fine-grained material to maintain adequate moisture and nutrient supply.

2. Sufficient pore space to permit root penetration. A bulk density of 1.2 to 1.5 indicates that sufficient pore space is present. A fine granular or crumb-like structure is also favorable.

3. Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans shall be 12 inches or more, except on slopes steeper than 2:1 where the addition of soil is not feasible.

4. A favorable pH range for plant growth. If the soil is so acidic that a pH range of 6.0-7.0 cannot be attained by addition of pH-modifying materials, then the soil is considered an unsuitable environment for plant roots and further soil modification would be required.

5. Freedom from toxic amounts of materials harmful to plant growth.

6. Freedom from excessive quantities of roots, branches, large stones, large clods of earth, or trash of any kind. Clods and stones may be left on slopes steeper than 3:1 if they do not significantly impede good seed soil contact.

If any of the above criteria cannot be met, i.e., if the existing soil is too coarse, dense, shallow, acidic, or contaminated to foster vegetation, then topsoil shall be applied in accordance with TOPSOILING, Std. & Spec. 3.30. Surfaces will be roughened in accordance with SURFACE ROUGHENING Std. & Spec. 3.29.

Soil Conditioners

In order to modify the texture, structure, or drainage characteristics of a soil, the following materials may be added to the soil:

1. Peat: is a very costly conditioner, but works well. If added, it shall be sphagnum moss peat, hypnum moss peat, reed-sedge peat or peat humus, from fresh-water sources. Peat shall be shredded and conditioned in storage piles for at least six months after excavation.
2. Sand: shall be clean and free of toxic materials. Sand modification is ineffective unless you are adding 80 to 90% sand on a volume basis. This is extremely difficult to do on-site. If this practice is considered, consult a professional authority to ensure that it is done properly.
3. Vermiculite: shall be horticultural grade and free of toxic substances. It is an impractical modifier for larger acreage due to expense.
4. Raw manure: is more commonly used in agricultural applications. However, when stored properly and allowed to compost, it will stabilize nitrogen and other nutrients. Manure, in its composted form, is a viable soil conditioner; however, its use should be based on site-specific recommendations offered by a professional in this field.

5. Thoroughly rotted sawdust shall have 6 pounds of nitrogen added to each cubic yard and shall be free of stones, sticks, and toxic substances.
6. The use of treated sewage sludge has benefited from continuing advancements in its applications in the agricultural community. When composted, it offers an alternative soil amendment. Limitations include a potentially undesirable pH (because of lime added during the treatment process) and the possible presence of heavy metals. This practice should be thoroughly evaluated by a professional and be used in accordance with any local, state, and federal regulations.

Lime and Fertilizer: Lime and fertilizer needs should be determined by soil tests. Soil tests may be performed by the Cooperative Extension Service Soil Testing Laboratory at VPI & SU, or by a reputable commercial laboratory. Information concerning the State Soil Testing Laboratory is available from county extension agents. *Under unusual conditions where it is not possible to obtain a soil test, the following soil amendments will be applied:

Lime:
Coastal Plain: 2 tons/acre pulverized agricultural grade limestone (90 lbs./1000 $ft.^2$).
Piedmont and Appalachian Region: 2 tons/acre pulverized agricultural grade limestone (90 lbs./1000 $ft.^2$).

Fertilizer:
Mixed grasses and legumes: 1000 lbs./acre 10-20-10 or equivalent nutrients (23 lbs./1000 $ft.^2$).
Legume stands only:1000 lbs./acre 5-20-10 (23 lbs./1000 $ft.^2$) is preferred; however, 1000 lbs./acre of 10-20-10 or equivalent may be used.
Grass stands only: 1000 lbs./acre 10-20-10 or equivalent nutrients, (23 lbs./1000 $ft.^2$). Other fertilizer formulations, including slow-release sources of nitrogen (preferred from a water quality standpoint), may be used provided they can supply the same amounts and proportions of plant nutrients.

Incorporation: Lime and fertilizer shall be incorporated into the top 4-6 inches of the soil by discing or other means whenever possible. For erosion control, when applying lime and fertilizer with a hydroseeder, apply to a rough, loose surface.

Seeding:
1. Certified seed: will be used for all permanent seeding whenever possible. Certified seed is inspected by the Virginia Crop Improvement Association or the certifying agency in other states. The seed must meet published state standards and bear an official "Certified Seed" label (see Appendix 3.32-a).
2. Legume seed: should be inoculated with the inoculant appropriate to the species. Seed of the Lespedezas, the Clovers and Crownvetch should be scarified to promote uniform germination.
3. Apply seed: uniformly with a broadcast seeder, drill, culti-packer seeder, or hydroseeder on a firm, friable seedbed. Seeding depth should be 1/4 to 1/2 inch.
4. To avoid poor germination rates as a result of seed damage during hydroseeding, it is recommended that if a machinery breakdown of 30 minutes to 2 hours occurs, 50% more seed be added to the tank, based on the proportion of the slurry remaining in the tank. Beyond 2 hours, a full rate of new seed may be necessary.

Often hydroseeding contractors prefer not to apply lime in their rigs as it is abrasive. In inaccessible areas, lime may have to be applied separately in pelletized or liquid form. Surface roughening is particularly important when hydroseeding, as a roughened slope will provide some natural coverage of

lime, fertilizer and seed.

Legume inoculants: should be applied at five times the recommended rate when inoculant is included in the hydroseeder slurry.

Mulching: All permanent seeding must be mulched immediately upon completion of seed application. Refer to MULCHING, Std. & Spec. 3.35.

Maintenance of New Seedings

In general, a stand of vegetation cannot be determined to be fully established until it has been maintained for one full year after planting.

Irrigation: New seedings should be supplied with adequate moisture. Supply water as needed, especially late in the season, in abnormally hot or dry weather, or on adverse sites. Water application rates should be controlled to prevent excessive runoff. Inadequate amounts of water may be more harmful than no water.

Re-seeding: Inspect seeded areas for failure and make necessary repairs and re-seedings within the same season, if possible.

a. If vegetative cover is inadequate to prevent rill erosion, over-seed and fertilize in accordance with soil test results.
b. If a stand has less than 40% cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. The soil must be tested to determine if acidity or nutrient imbalances are responsible. Re-establish the stand following seedbed preparation and seeding recommendations.

Fertilization: Cool season grasses should begin to be fertilized 90 days after planting to ensure proper stand and density. Warm season fertilization should begin at 30 days after planting. Apply maintenance levels of fertilizer as determined by soil test. In the absence of a soil test, fertilization should be as follows:

Cool Season Grasses

4 lbs. nitrogen (N) per 1000 $ft.^2$ per year
1 lb. phosphorus (P) per 1000 $ft.^2$ per year
2 lbs. potash (K) per 1000 $ft.^2$ per year

Seventy-five percent of the total requirements should be applied between September 1 and December 31st. The balance should be applied during the remainder of the year. **More than 1 lb. of soluble nitrogen per 1000 ft^2 should not be applied at any one time.**

Warm Season Grasses:

1. Apply 4-5 lbs. nitrogen (N) between May 1 and August 15th per 1000 $ft.^2$ per year.
2. Phosphorus (P) and Potash (K) should only be applied according to soil test.

*The use of slow-release fertilizer formulations for maintenance of turf is encouraged to reduce the number of applications and the impact on groundwater.

Additional Information on the Successful Establishment of Grasses and Legumes

See Appendix 3.32-b for "helpful hints" in achieving high success rates in grass or legume plantings.

APPENDIX 3.32-a
SEED QUALITY CRITERIA

Where certified seed is unavailable, the min. requirements are as follows:

a. All tags on containers of seed shall be labeled to meet the requirements of the State Seed Law.
b. All seed shall be subject to re-testing by a recognized seed laboratory that employs a registered seed technologist or by a state seed lab.
c. All seed used shall have been tested within twelve (12) months.
d. Inoculant - the inoculant added to legume seed in the seed mixtures shall be a pure culture of nitrogen-fixing bacteria prepared for the species. Inoculants shall not be used later than the date indicated on the container. Twice the supplier's recommended rate of inoculant will be used on dry seedings; five times the recommended rate if hydroseeded.
e. The quality of the seed used shall be shown on the bag tags to conform to the guidelines in Table 3.32-E.

TABLE 3.32-E
QUALITY OF SEED*

Legumes	Minimum Seed Purity(%)	Minimum Germination(%)
Crownvetch	98	65**
Lespedeza, Korean	97	85**
Lespedeza, Sericea	98	85**
Grasses		
Bluegrass, Kentucky	97	85
Fescue, Tall (Improved, Turf-Type Cultivars)	98	85
Fescue, Tall (Ky-31)	97	85
Fescue, Red	98	85
Redtop	94	80
Reed Canarygrass	98	80
Perennial Ryegrass	98	90
Weeping Lovegrass	98	87
Annuals		
Annual Ryegrass	97	90
German Millet	98	85
Oats	98	80
Cereal Rye	98	85

* Seed containing prohibited or restricted noxious weeds should not be accepted. Seed should not contain in excess of 0.5% weed seed. To calculate percent pure, live seed, multiply germination times purity and divide by 100.

Example: Ky-31 Tall Fescue with a germination of 85 percent and a purity of 97 %. 97 x 85 = 8245. 8245/100 = 82.45% pure live seed.

**Includes "hard seed"

APPENDIX 3.32-b
KEYS TO SUCCESSFUL ESTABLISHMENT OF GRASSES AND LEGUMES

Planning: Where feasible, grading operations should be planned around optimal seeding dates for the particular region. The most effective times for establishing perennial grass in Virginia generally extend from March through May and from August through October. Outside these dates, the probability of failure is much higher. If the time of year is not suitable for seeding a permanent cover (perennial species), a temporary cover crop should be planted. Temporary seeding of annual species (small grains, ryegrasses or millets) often succeeds during periods of the year that are unsuitable for seeding permanent (perennial) species. Variations in weather and local site conditions can modify the effects of regional climate on seeding success. For this reason, mixtures including both cool and warm season species are preferred for low-maintenance cover, particularly in the Coastal Plain. Such mixtures promote cover which can adapt to a range of conditions. Many of these mixtures are not desirable, however, for high quality lawns, where variation in texture of the turf is inappropriate. It is important to note that in Virginia the establishment of 100% warm season grasses in a high quality lawn is limited to the extreme eastern portions of the Coastal Plain.

Selection: Species selection should be considered early in the process of preparing an erosion and sediment control plan. A variety of vegetation can be established in Virginia due to the diversity in both soils and climate. However, for practical, economical stabilization and long-term protection of disturbed sites, species selection should be made judiciously. Seasonality must be considered when selecting species. Grasses and legumes are usually classified as warm or cool season in reference to their season of growth.

Cool season plants realize most of their growth during the spring and fall and are relatively inactive or dormant during the hot summer months. Therefore, fall is the most favorable time to plant them. Warm season plants "green-up" late in the spring, grow most actively during the summer, and go dormant at the time of the first frost in fall. Spring and early summer are preferred planting times for warm season plants.
Seed Mixtures: As previously noted, the establishment of high quality turf frequently involves planting one single species. However, in seedings for erosion control purposes, the inclusion of more than one species should always be considered. Mixtures need not be excessive in poundage or seed count. The addition of a quick-growing annual provides early protection and facilitates establishment of one or two perennials in a mix. More complex mixtures might include a quick-growing annual, one or two legumes and more than one perennial grass. The addition of a "nurse" crop (quick-growing annuals added to permanent mixtures) is a sound practice for soil stabilization, particularly on difficult sites - those with steep slopes; poor, rocky, erosive soils; those seeded out the optimum seeding periods; or in any situation where the development of permanent cover is likely to be slow. The nurse crop germinates and grows rapidly, holding the soil until the slower-growing perennial seedlings become established.

APPENDIX 3.32-c
PLANT INFORMATION SHEETS

1. **Tall Fescue** (Festuca arundinacea)

Uses: Pasture, hay, recreation areas, lawns and stabilization of waterways, banks, slopes, cuts, fills, and spoils. It is the most widely used grass at this time for stabilizing large disturbed areas.

Description: A robust, cool season, long-lived, deep-rooted bunchy grass which may have short rhizomes (underground stems). Kentucky 31 is the best-known variety. A number of new varieties of Tall Fescue are becoming available for lawn and other fine-turf uses, and several offer definite improvements. However, their higher cost over the old standby, KY 31, is seldom justified when used for purposes of stabilization and erosion control. Tall Fescue tolerates a wide range of seeding dates; however, with the possible exception of high mountain elevations, it is most dependable when planted in fall.

Adaptation: Adapts well to both high and low maintenance uses throughout Virginia. Adapted to a wide range of climatic conditions. Optimum pH range is 6.0 to 7.0; will tolerate from 3.0 to 8.0. Will grow on shallow and claypan soils if they are moist. Growth is limited more by moisture than by temperature extremes, but it will tolerate drought, infertile soils and shade.

Establishment: Requires a firm seedbed. Hydroseeding is successful. Seeding Rates vary from 100 lbs. per acre for erosion control to 250 lbs. per acre for lawns. Plant in early spring or from the middle of August through September. Legumes may not thrive in fescue stands due to the aggressive growth habits of this grass. Mowing is desirable on critical areas at least once every two years; lack of periodic mowing will encourage clumpiness.

Sources: Readily available as seed and sod.

2. Kentucky Bluegrass (Poa pratense)

Uses: Pasture, turf for lawns, athletic fields, golf courses, and playgrounds. Also used to stabilize waterways, slopes, cuts and fills. Choice food for grouse, turkeys, deer and rabbits.

Description: Long-lived, cool season perennial grass which forms a dense sod. Becomes dormant in the heat of summer since its growing season is spring and fall.

Adaptation: Best adapted to well - drained, fertile soils of limestone origin and the climate of northern and western Virginia. Optimum pH range is 6.0 to 7.0. Bluegrasses are better suited to high maintenance situations in the transitions zone. Essentially dormant during dry or hot weather; however, it will normally survive severe drought.

Establishment: Requires a firm, weed-free seedbed and adequate fertilization (liberal phosphorus) and lime are important. Can be used with Tall Fescues at low rates. Minimum mowing height is 1-1/2 inches. Critical erosion areas may be mowed only once per year, if desired. This grass is usually seeded with a mixture of other grasses or legumes; several varieties of Bluegrass should be used together to ensure good stand survival. Bare ground rates are 120 lbs. per acre. Overseed 1 to 1-1/2 lbs per 1000 square feet.

Sources: Readily available as seed and sod.

3. **Perennial Ryegrass** (Lolium perrenne)

Uses: Erosion control, soil improvement, lawns, pasture, and hay; newer varieties are excellent for high-traffic areas.
Description: Perennial Ryegrasses are an excellent selection where rapid establishment is desired. Cool season Ryegrasses cross-pollinate freely so "Common Ryegrass" may be a mixture of annual and perennial species. Certified seed of Perennial Ryegrass varieties is produced: Blaser, Palmer, Goalie, Fiesta II, Ranger, Regal and Pennfine may be used in Virginia.

Establishment: A firm, shallow surface over compact subsoil gives good results. Seed in fall or spring. Perennial Ryegrass may also be seeded in Mid-August to early September. For turf, use a rate of 5 to 8 lbs. per 1000 square feet, if seeded alone; lesser amounts are suitable in mixtures, depending on the characteristics of the companion species. Generally not seeded alone except on athletic fields with intensive use. Perennial Ryegrass does best when used with Bluegrass as 20 percent or less of the mixture. Ryegrasses germinate rapidly, which makes them particularly suited to disturbed-area stabilization and temporary seeding. They will, however, tend to dominate stands in mixtures if percentage is too high.

Sources: Readily available commercially. Care should be taken to buy seed appropriate to the needs of the project.

4. **Bermudagrass** (Cynodon dactylion)

Uses: Soil and water conservation, pasture, hay, silage, lawns, both high maintenance and general purpose turf, and stabilization of grassed waterways.

Description: A long-lived, warm season perennial that spreads by stolons and rhizomes (runners and underground stems). Height of stems of Common Bermudagrass may be 12 inches. The stems are short-jointed and the leaves flat and spreading.

Common Bermudagrass may be established vegetatively with sprigs (sections of stems) or from seeds; however, it has the potential to develop into a weed problem because it spreads vigorously. Cold-tolerant hybrids are usually specified. These are traditionally established from sprigs or sod, but seed is now available.

Adaptation: Southern Piedmont and Costal Plain in Virginia and some southern Appalachian ridges and valleys. Check Std. & Spec. 3.34 for regional adaptations of varieties. Makes its best growth when average daily temperatures are above 75 degrees. Grows on a wide range of soils from heavy clays to deeps sands. Optimum pH is 6.0 to 6.5. It is drought-resistant and salt-tolerant. Tolerates floods of short duration but will not thrive on waterlogged soils; does not persist under heavy shade. For rough areas, the varieties Midland (a forage hybrid) and Coastal are recommended. For fine-turf areas, Tufcote (a fine-leaved turf hybrid), Midiron, Tifway, and Vamont are used in Virginia.

Establishment: By sodding or planting sprigs. Sprigs should be planted (by hand or machine) when soil is warm in a well-prepared, moist seedbed. One end of the sprig should extend above ground, and the other should be covered by firmly packed soil.

Sources: Readily available as seed, sprigs, and sod.

5. **Redtop** (Agrostis alba)

Uses: Erosion control, pasture, companion grass in turf seedings and stabilizing ditch and channel banks, grassed waterways, and other disturbed areas.

Description: A coarse, cool season perennial grass with rhizomes (underground stems). Grows to 30 to 40 inches.

Adaptation: Throughout Virginia; does better in the cool, humid areas. Will grow under a wide variety of soil and moisture conditions. Grows on very acid soils of low fertility. While drought-resistant, it is also a useful wetland grass.

Establishment: Has very small seed and requires a compact seedbed. May be sown in early spring or late summer. Seldom seeded alone except as temporary turf. Adequate fertilization is essential on critical areas to obtain good cover rapidly. Most commonly added to mixes, usually 2 to 3 lbs. per acre. Redtop will disappear from a stand under frequent low mowing.

6. **Crownvetch** (Coronilla varia)

Uses: For erosion control of critical areas such as steep roadbanks, surface mine spoils and industrial waste areas. It is also useful as a residential ground cover. It provides high-quality forage for ruminant animals and serves as a wildlife food and cover plant.

Description: A deep-rooted, cool season, perennial, herbaceous legume with a semi-reclining growth habit. It reaches 2 to 3 feet in height, and does not climb or twine. It fixes nitrogen in the soil and makes a dense mat of vegetative cover.
Adaptation: Best adapted to the northern Piedmont and Mountain regions of Virginia. It grows best on well-drained soils with a pH range of 5.5 to 8.3. It will persist on more acid soils for a prolonged period once established. It is not adapted to soils with poor drainage. Crownvetch is winter-hardy and drought tolerant. Varieties commonly used are Chemung, Penngift, and Emerald.

Establishment: Only inoculated seed should be used. Requires at least 500 lbs. per acre of 5-10-10 fertilizer (or the area should be fertilized according to soil test results). Soil acidity must be raised above a pH of 5.5. Crownvetch requires mulch and can be hydroseeded successfully.

Seeding in the spring is most successful. Frost-seeding may be used on steep or stony sites (seed in late winter, and allow frost action to work the seed into soil). Crownvetch often takes 2 to 3 years to establish a dense stand. A companion grass such as Perennial Ryegrass or Redtop needs to be mixed into the initial planting, but the Crownvetch will eventually crowd out the companion plants. It will not persist under frequent mowing.

7. **Sericea Lespedeza** (Lespedeza cuneata)

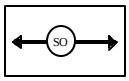
Uses: Hay, pasture, erosion control, cover crop, wildlife food.

Description: Warm season perennial legume with upright woody stems 12 to 18 inches tall. Roots widely branched penetrating soil 3 feet or more.

Adaptation: Well adapted to all parts of Virginia. Best on well-drained, deep soils of medium texture. Will also grow on sandy, rather acidic, infertile soils. Most often the legume of choice for eastern Virginia. Optimum pH range is 6.0 to 6.5, but will tolerate a range of 5.0 to 7.0. It is drought-tolerant. Common varieties in Virginia are Serala and Interstate.

Establishment: Seed from April to June. Requires a firm seedbed. Use only inoculated seed. Rates vary from 20 to 30 lbs. of unhulled seed per acre. Requires phosphate and potash. Will not persist under frequent mowing (once a year recommended).

STD & SPEC 3.33
SODDING



SO

Practice Description

Stabilizing fine-graded disturbed areas by establishing permanent grass stands with sod. It is utilized for the following:

1. To establish permanent turf immediately.
2. To prevent erosion and damage from sediment and runoff by stabilizing the soil surface.
3. To reduce the production of dust and mud associated with bare soil surfaces.
4. To stabilize drainageways where concentrated overland flow will occur.
5. For use as a filtering device for sediments in areas prior to achieving permanent stabilization.

Conditions Where Practice Applies

1. Disturbed areas which require immediate vegetative covers, or where sodding is preferred to other means of grass establishment.
2. Locations particularly suited to stabilization with sod are:
   a.) Waterways carrying intermittent flow
   b.) Around drop inlets or in grassed swales
   c.) Residential or commercial lawns where quick use or aesthetics are factors

Specifications

Soil Preparation

1. Prior to soil preparation, areas to be sodded shall be brought to final grade in accordance with the approved plan.
2. Soil tests should be made to determine the exact requirements for lime and fertilizer. The State Laboratory at VPI & SU or a reputable commercial laboratory may conduct soil tests. Information on state soil tests is available from county or city agricultural extension agents. *Under circumstances where it is not possible to obtain a soil test, the following soil amendments shall be made:
   Pulverized agricultural limestone at 90 lbs./1000 sq. ft. (2 tons/acre).
   Fertilizer at 25 lbs./1000 sq. ft. (1000 lbs./acre) of 10-10-10 in fall, or 25 lbs./1000 sq. ft. of 5-10-10 in spring. These amendments shall be spread evenly over the area to be sodded, and incorporated into the top 3 to 6 inches of the soil by discing, harrowing or other means.
3. Prior to laying sod, the soil surface shall be clear of trash, debris, large roots, branches, stones and clods in excess of 1 inch in length or diameter. Sod shall not be applied to gravel or other non-soil surfaces.
4. Any irregularities in the soil surface resulting from top-soiling or other operations shall be filled or leveled in order to prevent the formation of depressions or water pockets.
5. Areas to be topsoiled and topsoil used shall fulfill the requirements of TOPSOILING, Std. & Spec. 3.30. No sod shall be spread on soil which has been treated with soil sterilants or any other toxic herbicides until enough time has elapsed to permit dissipation of toxic materials.

Quality of Sod

1. Sod used shall be state-certified. Certified turfgrass sod is grown from Certified seed, inspected and certified by the Virginia Crop Improvement Association (VCIA) or the certifying agency in other states. This ensures genetic purity, high quality, freedom from noxious weeds and excessive insect or disease problems. The sod must meet published state standards and bear an official blue "Certified Turf" label on the bill of lading.
2. High-quality sod is also available outside of the VCIA certified sod program. When purchasing this sod, the consumer is encouraged to be aware of factors which are important in determining sod quality. High-quality sod will contain the best varieties and be free of serious disease, insect, or weed problems. It will be dense, have good color, and hold together well.
3. Sod shall be machine cut at a uniform soil thickness of 3/4 inch (± 1/4 inch) at the time of cutting. This thickness shall exclude shoot growth and thatch.
4. Pieces of sod shall be cut to the supplier's standard width and length, with a maximum allowable deviation in any dimension of 5%. Torn or uneven pads will not be acceptable.
5. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended from a firm grasp on one end of the section.
6. Sod shall not be cut or laid in excessively wet or dry weather.
7. **Sod shall be harvested, delivered, and installed within a period of 36 hours.**

Choosing Appropriate Types of Sod

The type of sod used must be composed of plants adapted to the locality. Use Table 3.33-A to select the type of sod best suited to your area.

Sod Installation (See Plate 3.33-1)

1. Sod should not be laid on soil surfaces that are frozen.
2. During periods of high temperature, the soil shall be lightly irrigated immediately prior to laying the sod, to cool the soil and reduce root burning and dieback.
3. The first row of sod shall be laid in a straight line with subsequent rows placed parallel to and butting tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to ensure that sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause drying of the roots.
4. On slopes 3:1 or greater, or wherever erosion may be a problem, sod shall be laid with staggered joints and secured by stapling or other approved methods. Sod shall be installed with the length perpendicular to the slope (on the contour).
5. As sodding of clearly defined areas is completed, sod shall be rolled or tamped to provide firm contact between roots and soil.
6. After rolling, sod shall be irrigated to a depth sufficient that the underside of the sod pad and the soil 4 inches below the sod are thoroughly wet.
7. Until such time a good root system becomes developed, in the absence of adequate rainfall, watering shall be performed as often as necessary to maintain moist soil to a depth of at least 4 inches.
8. The first mowing shall not be attempted until the sod is firmly rooted, usually 2-3 weeks. Not more than one third of the grass leaf shall be removed at any one cutting.

Sodded Waterways

1. Care should be taken to prepare the soil adequately in accordance with this specification. The sod type shall consist of plant materials able to withstand the designed velocity (see STORMWATER CONVEYANCE CHANNELS, Std. & Spec. 3.17).
2. Sod strips in waterways shall be laid perpendicular to the direction of flow. Care should be taken to butt ends of strips tightly.
3. After rolling or tamping, sod shall be pegged or stapled to resist washout during the establishment period. Jute mesh or other netting may be pegged over the sod for extra protection in critical areas.
4. All other specifications for this practice shall be adhered to when sodding a waterway.

TABLE 3.33-A
TYPE OF SOD AVAILABLE IN VIRGINIA
AND RECOMMENDED USES

Kentucky Bluegrass: Adapted to the Northern Piedmont and Mountain Regions. Individual varieties selected must make up not less than 10%, not more than 35% of the total mixture on a weight basis. All varieties must be certified. Selections can be made from Category I alone or various combinations of Categories I, II and III, as noted.

Category I:	Recommended Kentucky Bluegrass Varieties
65% - 100%	A-34, Abbey, Aspen, Asset, Baron, Blacksburg, Bristol, Cheri, Chateau, Classic, Coventry, Georgetown, Glade, Haga, Julia, Liberty, Loft's 1757, Merit, Midnight, Monopoly, Plush, Princeton 104, Rugby, Suffolk, Victa
Category II:	Special use varieties. If used, must contain at least 65% Category I varieties
Shade Tolerant	
10-35%	Bristol, Columbia, Georgetown, Glade, Midnight
Low-Maintenance Tolerant	
10-35%	Columbia, Georgetown, Monopoly, Ram I, Touchdown, Victa
Category III:	Promising Kentucky Bluegrass - Limited performance data or seed availability
10-35%	Dawn, Estate, Freedom, Kelly

Maintenance of Established Sod

1. During the 2 to 3 week establishment stage, sod shall be watered as necessary to maintain adequatemoisture in the root zone and prevent dormancy of sod.
2. No more than one third of the shoot (grass leaf) should be removed in any mowing. Grass height should be maintained between 2 and 3 inches unless otherwise specified.
3. After the first growing season, established sod will require fertilization and may require lime. Follow soil test recommendations when possible, or apply maintenance levels as outlined in Table 3.33-B.

TABLE 3.33-A (CONTINUED)
SOD TYPES AVAILABLE
IN VIRGINIA & RECOMMENDED USES

Tall Fescue: Adapted to the entire state.

Recommended Tall Fescue Varieties:

90-100% Amigo, Apache, Bonanza, Chieftain, Finelawn 5GL, Mesa, Rebel II, Shenandoah, Tribute

Promising Tall Fescues

Certified Arriba, Austin, Avanti, Aztec, Cochise, Crossfire, Eldorado, Hubbard 87, Jaguar II, Maverick II, Monarch, Olympic II, Phoenix, Safari, Shortstop, Sundance, Taurus, Thoroughbred, Titan, Tradition, Vegas, Winchester, Wrangler

0-10% Kentucky Bluegrass: Baron, Cheri, Columbia, Monopoly, Nassau, Ram I, Victa

Bermuda grass: Tufcote is adapted to the Richmond-Danville-Newport News triangle. Midiron may be used east of Roanoke and south of Charlottesville. Tifgreen and Tifway may be used to the east and south of Richmond. Vamont may be used east of Roanoke and at lower elevations in southwestern Virginia.

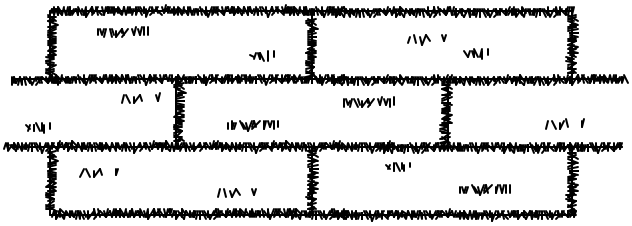
Certified Midiron, Tifgreen#, Tifway, Tifway II, Tufcote and Vamont

Zoysiagrass: This sod performs best in southeastern Virginia. Meyer, Emerald#

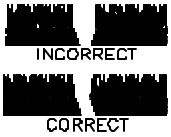
Note: Common Bermudagrass is not recommended for sod production.

Only recommended in southeastern Virginia.

SODDING

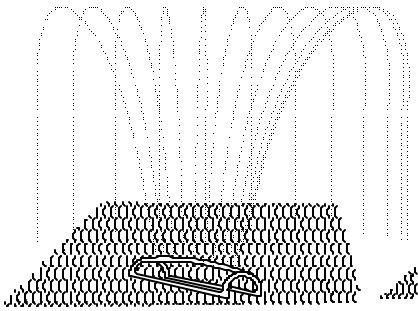


LAY SOD IN A STAGGERED PATTERN. BUTT THE STRIPS TIGHTLY AGAINST EACH OTHER. DO NOT LEAVE SPACES AND DO NOT OVERLAP. A SHARPENED MASON'S TROWEL IS A HANDY TOOL FOR TUCKING DOWN THE ENDS AND TRIMMING PIECES.

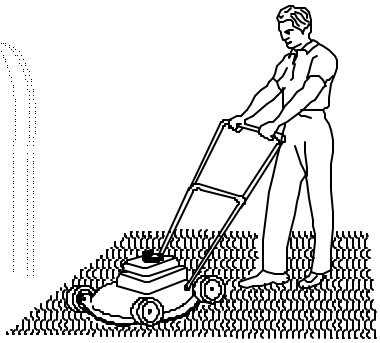


BUTTING – ANGLED ENDS CAUSED BY THE AUTOMATIC SOD CUTTER MUST BE MATCHED CORRECTLY.

ROLL SOD IMMEDIATELY TO ACHIEVE FIRM CONTACT WITH THE SOIL.

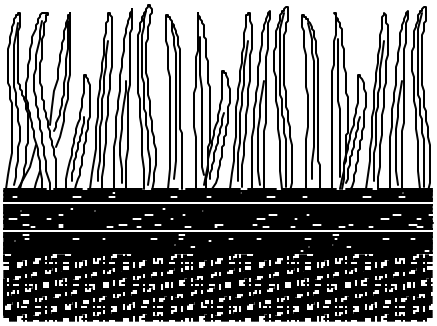


WATER TO A DEPTH OF 4" AS NEEDED WATER WELL AS SOON AS THE SOD IS LAID.



MOW WHEN THE SOD IS ESTABLISHED – IN 2–3 WEEKS. SET THE MOWER HIGH (2"–3")

APPEARANCE OF GOOD SOD



SHOOTS OR GRASS BLADES GRASS SHOULD BE GREEN AND HEALTHY, MOWED AT A 2"–3" CUTTING HEIGHT

THATCH – GRASS CLIPPINGS AND DEAD LEAVES, UP TO 1/2" THICK.

ROOT ZONE – SOIL AND ROOTS, SHOULD BE 1/2"–3/4" THICK, WITH DENSE ROOT MAT FOR STRENGTH.

SOURCE: VA. DSWC

PLATE: 3.33–1

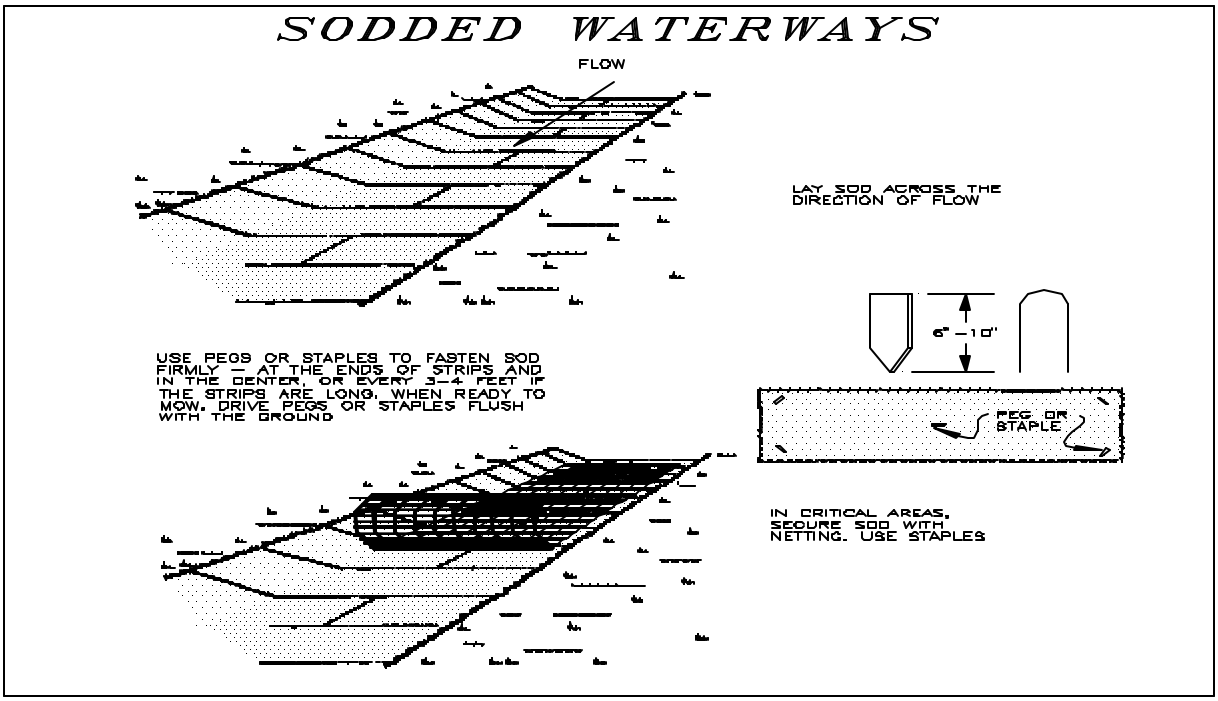


TABLE 3.33-B
MAINTENANCE FERTILIZATION
OF ESTABLISHED SOD

Cool Season Grasses
4 lbs. nitrogen (N) per 1000 sq. ft./year
1 lb. phosphorus (P) per 1000 sq. ft./year
2 lbs. Potash (K) per 1000 sq. ft./year

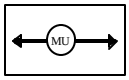
75% of the total requirements should be applied between September 1 and December 31st.The balance should be applied during the remainder of the year.

Warm Season Grasses
Apply 4-5 lbs. nitrogen (N) per 1000 sq. ft. per year (between May 1st and August 15th).

Phosphorus (P) and Potash (K) should only be applied according to soil tests.

Maintenance fertilizations should utilize slow release fertilizers which reduce the number of applications per year and subsequently reduce the adverse impacts on groundwater.

STD & SPEC 3.35
MULCHING



MU

Practice Description

Application of plant residues or other suitable materials to the soil surface, to prevent erosion by protecting the soil surface from raindrop impact and reducing the velocity of overland flow and to foster the growth of vegetation by increasing available moisture and providing insulation against extreme heat and cold.

Conditions Where Practice Applies

1. Areas which have been permanently seeded (see Std. & Spec. 3.32, PERMANENT SEEDING) should be mulched immediately following seeding.

2. Areas which cannot be seeded because of the season should be mulched to provide some protection to the soil surface. An organic mulch should be used, and the area then seeded as soon weather or seasonal conditions permit. It is not recommended that fiber mulch be used alone for this practice; at normal application rates it just simply does not provide the protection that is achieved using other types of mulch.

3. Mulch may be used together with plantings of trees, shrubs, or certain ground covers which do not provide adequate soil stabilization by themselves.

4. Mulch shall be used in conjunction with temporary seeding operations as specified in TEMPORARY SEEDING, Std. & Spec. 3.31.

Specifications

Organic Mulches

Organic mulches may be used in any area where mulch is required, subject to the restrictions noted in Table 3.35-A.

Materials: Select mulch material based on site requirements, availability of materials, and availability of labor and equipment. Table 3.35-A lists the commonly used organic mulches. Materials, such as peanut hulls and cotton burs, may be used with the permission of the local Plan-Approving Authority.
Prior to mulching: Complete the required grading and install needed sediment control practices.

Lime and fertilizer should be incorporated and surface roughening accomplished as needed. Seed should be applied prior to mulching except in the following cases:

a. Where seed is to be applied as part of hydroseeder slurry containing fiber mulch.
b. Where seed is to be applied following a straw mulch spread during winter months.

TABLE 3.35–A
ORGANIC MULCH MATERIALS AND APPLICATION RATES

MULCHES:	RATES:		NOTES:
	Per Acre	Per 1000/SQ. FT.	
Straw or Hay	1 1/2 –2 tons (Min. 2 tons for winter cover)	70–90 lbs.	Free from weeds and coarse matter. Must be anchored. Spread with mulch blower or by hand.
Fiber Mulch	Minimum 1500 lbs.	35 lbs.	Do not use as mulch for winter cover or during hot, dry periods* Apply as slurry.
Corn Stalks	4–6 tons	185–275 lbs.	Cut or Shredded in 4–6" lengths. Air–dried. Do not use in fine turf areas. Apply with mulch blower or by hand.
Wood Chips	4–6 tons	185–275 lbs.	Free of coarse matter. Air–dried. Treat with 12 lbs. nitrogen per ton. Do not use in fine turf areas. Apply with mulch blower or by hand.
Bark Chips or Shredded Bark	50–70 cu. yds.	1–2 cu. yds	Free of coarse matter. Air–dried. Treat with 12 lbs. nitrogen per ton. Do not use in fine turf areas. Apply with mulch blower,chip handler or by hand.

* When fiber mulch is the only available mulch during periods when straw should be used, apply at a minimum rate of 2000 lbs./ac. or 45 lbs./1000 sq. ft.

Application: Mulch materials shall be spread uniformly, by hand or machine.
When spreading straw mulch by hand, divide the area to be mulched into approximately 1,000 sq. ft. sections and place 70-90 lbs. (1½ to 2 bales) of straw in each section to facilitate uniform distribution.

Mulch Anchoring: Straw mulch must be anchored immediately after spreading to prevent displacement. Other organic mulches listed in Table 3.35-A do not require anchoring. The following methods of anchoring straw may be used:

1. Mulch anchoring tool (often referred to as a Krimper or Krimper Tool): This is a tractor-drawn implement designed to punch mulch into the soil surface. This method provides good erosion control with straw. It is limited to use on slopes no steeper than 3:1, where equipment can operate safely. Machinery shall be operated on the contour.

2. Fiber Mulch: A very common practice with widespread use today. Apply fiber mulch by means of a hydroseeder at a rate of 500-750 lbs./acre over top of straw mulch or hay. It has an added benefit of providing additional mulch to the newly seeded area.

3. Liquid mulch binders: Application of liquid mulch binders and tackifiers should be heaviest at edges of areas and at crests of ridges and banks, to prevent displacement. The remainder of the area should have binder applied uniformly. Binders may be applied after mulch is spread or may be sprayed into the mulch as it is being blown onto the soil.

   The following types of binders may be used:

   a. Synthetic binders - Formulated binders or organically formulated products may be used as recommended by the manufacturer to anchor mulch.

4. Mulch nettings: Lightweight plastic, cotton, or paper nets may be stapled over the mulch according to manufacturer's recommendations.

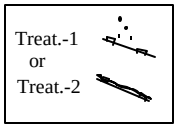
Chemical Mulches

Chemical mulches may be used in accordance with the manufacturers recommendations.

Maintenance

All mulches and soil coverings should be inspected periodically (particularly after rainstorms) to check for erosion. Where erosion is observed in mulched areas, additional mulch should be applied. Nets and mats should be inspected after rainstorms for dislocation or failure. If washouts or breakage occur, re-install netting or matting as necessary after repairing damage to the slope or ditch. Inspections should take place up until grasses are firmly established. Where mulch is used in conjunction with ornamental plantings, inspect periodically throughout the year to determine if mulch is maintaining coverage of the soil surface; repair as needed.

STD & SPEC 3.36
SOIL STABILIZATION
BLANKETS & MATTING



B/M

Practice Description

The installation of a protective covering (blanket) or a soil stabilization mat on a prepared planting area of a steep slope, channel or shoreline, to aid in controlling erosion on critical areas by providing a microclimate which protects young vegetation and promotes its establishment. In addition, some types of soil stabilization mats are also used to raise the maximum permissible velocity of turf grass stands in channelized areas by "reinforcing the turf" to resist the forces of erosion during storm events.

Conditions Where Practice Applies

On short, steep slopes where erosion hazard is high and planting is likely to be too slow in providing adequate protective cover; in vegetated channels where the velocity of design flow exceeds "allowable" velocity; on streambanks or tidal shorelines where moving water is likely to wash out new plantings; or in areas where the forces of wind prevent standard mulching practices from remaining in place until vegetation becomes established.

TREATMENT-1: SOIL STABILIZATION BLANKET

(Allowable Velocity Range During Vegetation Establishment: 0-4 f.p.s)

Materials

1. Combination Blankets - Shall consist of a photo-degradable plastic netting which covers and is entwined in a natural organic or man-made mulching material. The mulching material shall consist of wood fibers, wood excelsior, straw, coconut fiber, or man-made fibers. The blanket shall be of consistent thickness with the mulching material/fibers evenly distributed over its entire length. The mulching material/fibers must interlock or entwine to form a dense layer that not only resists raindrop impact, but will allow vegetation to penetrate the blanket. The blanket shall be nontoxic to vegetation and to the germination of seed and shall not be injurious to the unprotected skin of humans. At a minimum, the plastic netting must cover the top side of the blanket and possess a high web strength. The netting shall be entwined with the mulching material/fiber to maximize strength and provide for ease of handling.

2. Jute Mesh - It shall be a uniform, open, plain weave, of undyed and unbleached single jute yarn. The yarn shall be a loosely twisted construction and shall not vary in thickness by more than one half of its normal diameter. Jute mesh shall be new and shall conform to the following:

    a. Length of jute mesh shall be marked on each roll.
    b. There shall be 0.60-inch openings (+/- 25%) between strands, lengthwise.
    c. There shall be 0.90-inch openings (+/- 25%) between strands, widthwise.

d. Weight shall average 0.90 lbs./square yard with a tolerance of 5%.

As previously noted, jute can be used alone as a blanket.

2. Other **Teatment-1** Products - These shall conform to manuacturer's specifications and be approved by the Plan-Approving Authority prior to being specified for a particular application. These products should be installed in accordance with manufacturer's recommendations, provided those recommendations are at least as stringent as this specification. Again, it is recommended that VDOT's "Approved Products List" be consulted. In no case shall these products cover less than 30% of the soil surface.

3. Staples - Staples for anchoring Treatment-1 shall be No. 11-gauge wire of heavier. Their length shall be a minimum of 6 inches. A larger staple with a length of up to 12 inches should be used on loose, sandy, or unstable soils.

Installation Requirements

Site Preparation - After site has been shaped and graded to approved design, prepare a friable seedbed relatively free from clods and rocks more than 1½inches in diameter and any foreign material that will prevent uniform contact of the protective covering with the soil surface.

Planting - Lime, fertilize, and seed in accordance with seeding or other type of planting plan. When using jute mesh on a seeded area, apply approximately one-half the seed after laying the mat. The protective covering can be laid over sprigged areas where small grass plants have been inserted into the soil.

Where ground covers are to be planted, lay the protective covering first and then plant through the material as per planting design.

When open-weave nets are used, lime, fertilizer, seed and mulch should be applied before laying the net. When a combination blanket (such as an "excelsior" blanket) is used, seed and soil amendments must also be applied before the blanket is laid.

Orientation - See Manufacturer's specifications for orientation of **Treatment-1** for different topographic conditions.

Laying and Stapling (see Plate 3.36-2) - If instructions have been followed, all needed check slots will have been installed, and the protective covering will be laid on a friable seedbed free from clods, rocks, roots, etc. that might impede good contact.

1. Start laying the protective covering from the top of the channel or top of slope and unroll down-grade.
2. Allow to lay loosely on soil - do not stretch.
3. Upslope ends of the protective covering should be buried in an anchor slot no less than 6-inches deep. Tamp earth firmly over the material. Staple the material at a minimum of every 12 inches across the top end.

4. Edges of the material shall be stapled every 3 feet. Where multiple widths are laid side by side, the adjacent edges shall be overlapped a minimum of 2 inches and stapled together.
5. Staples shall be placed down the center, staggered with the edges at 3 foot intervals.

Check slots - On highly erodible soils and on slopes steeper than 4:1, erosion check slots should be made every 50 feet (see Plate 3.36-2). Insert a fold of the material (separate piece) into a 6-inch trench and tamp firmly. Staple fold to "main" blanket at minimum 12-inch intervals across the upstream and downstream portion of the blanket.

Note: Many combination blankets are designed and manufactured to resist movement and uplift to a point which check slots may not be required. Plan designers and review authorities are urged to study manufacturers' recommendations and site conditions.

Joining Protective Coverings - Insert a new roll of material into an anchor slot, as with upslope ends. Overlap the end of the previous roll a minimum of 12 inches, and staple across the end of the roll just below the anchor slot and across the material every 12 inches.

Terminal End - At the point at which the material is discontinued, or at which time the protective covering meets a structure of some type, fold 4 inches of the material underneath and staple every 12 inches (minimum).

At bottom of slopes - Lead net out onto a level area before anchoring. Turn ends under 4 inches, and staple across end every 12 inches.

Final Check - These installation techniques must be adhered to:
1. Protective blanket is in uniform contact with the soil.
2. All lap joints are secure.
3. All staples are driven flush with the ground.
4. All disturbed areas have been seeded.

TREATMENT-2: SOIL STABILIZATION MATTING
(Allowable velocity range after vegetative establishment: 0 - 10 f.p.s.)

Materials

Matting - The majority of these products provide a three dimensional geomatrix of nylon, polyethylene, or randomly oriented monofilaments, forming a mat. These products contain ultra violet (UV) inhibiting stabilizers, added to the compounds to ensure endurance and provide "permanent root reinforcement."

The three dimensional feature creates an open space which is allowed to fill with soil. The roots of the grass plant become established within the mat itself, forming a synergistic root and mat system. As the grass becomes established, the two actually "reinforce" each other, preventing movement or damage to the soil. Allowable velocities are increased considerably over natural turf stands.

Selection of the appropriate matting materials along with proper installation become critical factors in the success of this practice. VDOT's "Approved Products List" can be a real asset in the selection process. Consultation with the supplier or the manufacturer and thorough evaluation of performance data to ensure proper selection of a soil stabilization matting are also essential. Although many manufacturers claim their products may inhibit erosion associated with channel velocities of up to 20 ft./sec., it is recommended that any velocities that exceed 10 ft./sec. be properly protected with some form of structural lining (see Std. & Spec. 3.17, STORMWATER CONVEYANCE CHANNEL).

Staples - Staples or anchoring methods and recommendations vary by manufacturers. The expectation of high velocities should dictate the use of more substantial anchoring.

Installation Requirements

Site Preparation - After site has been shaped and graded to approved design, prepare a friable seedbed relatively free from clods and rocks more than 1 inch in diameter, and any foreign material that will prevent contact of the soil stabilization mat with the soil surface. If necessary, redirect any runoff away from the ditch or slope during installation.

Planting - Lime, fertilize and seed in accordance with MS #1 and the approved plan, paying special attention to the plant selection that may have been chosen for the matted area. If the area has been seeded prior to installing the mat, make sure and reseed all areas disturbed during installation.

Mulching - Mulch (normally straw) should be applied following installation of **Treatment-2** at rates noted in Std. & Spec. 3.35, MULCHING.

Laying and Securing - See Plates 3.36-4, 3.36-5 and 3.36-6. Similar to installing **Treatment-1**, but Plan Approving Authority's requirements or manufacturer's recommendations must be followed as detailed. The key to achieving desired performance is dependent upon proper installation.

Check Slots - See Plate 3.36-4. Matting manufacturers vary significantly in their check slot requirements. Similar to the installation of **Treatment-1**, a check slot may be required when laying **Treatment-2** to

"correct" the flow of water if it has the potential to undermine the matting. Most authorities (including VDOT) require that the sides of the matting also be entrenched, creating a slope shelf for the material to rest on, preventing water from entering under the mat on the sides.

Securing the Material and Joining Mats - Again, product specifications vary - upstream and downstream terminal slots, new roll overlaps and multiple width installations differ by various products and manufacturers.

Final Check - These installation techniques must be adhered to:

1. Soil stabilization mat is in uniform contact with the soil.
2. All required slots and lapped joints are in place.
3. The material is properly anchored.
4. All disturbed areas are seeded.

Maintenance

All soil stabilization blankets and matting should be inspected periodically following installation, particularly after rainstorms to check for erosion and undermining. Any dislocation or failure should be repaired immediately. If washouts or breakage occurs, re-install the material after repairing damage to the slope or ditch. Continue to monitor these areas until which time they become permanently stabilized; at that time an annual inspection should be adequate.